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GOALS OF THE SOVIET SEVEN YEAR PLAN (1959-65)
FOR TECHNICAL CHANGES
IN THE NONAGRICULTURAL BRANCHES
OF THE ECONOMY



CIA/RR ER 62-25

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CENTRAL INTELLIGENCE AGENCY
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W A R N I N G

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FOREWORD

This report consists of a summary of Soviet plans for technical changes in various branches of the economy, with the principal exceptions of agriculture and retail trade. The plans discussed are those now operative during the period of the Seven Year Plan (1959-65). Data on the Soviet industrial labor force and the productivity of various sectors of the economy are based on a wide variety of Soviet statistics of varying degrees of reliability or comparability and, although they are useful indications of the general orders of magnitude, they must be regarded as tentative. It should further be stressed that this report is concerned only with Soviet goals and therefore should not be considered as an estimate of expected achievements.

Data in this report are, for the most part, from Soviet announcements of goals for the Seven Year Plan or from articles in Soviet technical trade journals. No material used in the preparation of this report is classified higher than SECRET. Complete lists of source references and methodologies are available in the files of this Office.

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GOALS OF THE SOVIET SEVEN YEAR PLAN (1959-65) FOR TECHNICAL CHANGES
IN THE NONAGRICULTURAL BRANCHES OF THE ECONOMY*

Summary and Conclusions

Under the Soviet Seven Year Plan (1959-65), industrial production is to increase 80 percent, whereas industrial employment is to increase no more than about 24 percent. Achievement of these goals will imply a major increase in labor productivity.

At present the level of labor productivity in most branches of Soviet industry is far below that of the US. Soviet planners expect, however, to achieve rapid improvement in this field and approach a level of labor productivity comparable to that of the US by (1) supplying more and better machinery by means of a large capital investment program, (2) improving the organization of production (including increased specialization of production facilities and more use of mass-production techniques), (3) improving the training and utilization of labor, and (4) using more advanced forms of technology (including automation).

During the period of the Seven Year Plan, automation, as it is understood in the West, will not play a major role in Soviet industry as a whole -- although significant applications will be made in the electric power, oil and gas, and metallurgical industries. In Soviet industry generally, emphasis will be on the installation of integrated production flow lines, the mechanization of labor-intensive operations such as the transport and handling of materials within plants, the use of improved data-processing and production control, and the replacement of obsolete plants and equipment with modern and more productive counterparts.

Potential gains from the introduction of relatively simple mechanization of labor-intensive tasks are substantial. In 1958, for example, about 3.7 million workers were employed in the transport and handling of materials within plants. Although 75 percent of the materials were moved with the use of mechanical handling equipment, at least half of the workers did a significant amount of manual labor. The Seven Year Plan calls for an increase in labor productivity of 55 to 60 percent and an estimated increase of 38 percent in the volume of material moved, with an implied labor saving in 1965 of almost 2 million workers.

For a summary of factors relating to productivity in the Soviet Seven Year Plan for the major sectors of the economy, see Table 1.**

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 July 1962.

** Table 1 follows on p. 2.

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Factors Relating to Productivity in the Soviet Seven Year Plan (1959-65)
by Major Sector of the Economy a/

Table 1

State Industry	Number of Employees as of the end of 1958 (Thousand Persons) b/	Seven Year Plan		Percent Increase
		Total Capital Investment (Billion new rubles)	Production	
Metalworking and machine building	4,932	11.8	88	70
Wood and allied products	2,252	5.8 to 6.0	59 ^{1/2} /	53 ^{1/2} /
Construction materials	1,072	7.7 to 7.8	150	60
Light	2,515	3.3	50	36 ^{1/2} /
Food processing	1,649	4.7 to 5.3	72	50
Chemical	700 ^{e/}	10.0 to 10.5	200	50 ^{1/2} /
Ferrous metallurgy	607	10.0	60 ^{1/2} /	45
Nonferrous metallurgy	400 ^{e/}	5.5	100	80
Coal	1,071	7.5 to 7.8	23	30
Electric power ^{f/}	222	12.5 to 12.9	140	90 ^{1/2} /
Oil and gas ^{g/}	138	17.0 to 17.3	150	50
Other	721 ^{1/2} /	N.A.	N.A.	N.A.
Total	16,272	104.0	80	45 to 50
Other activities				
Construction	4,890 ^{1/2} /	3.3	60	60 to 65
Railroad transport	1,977 ^{1/2} /	11.0 to 11.5	39 to 43	34 to 37
Communications	664 ^{1/2} /	1.5	71 ^{1/2} /	30 to 35

a. Excluding agriculture, retail trade, and common carrier transport other than railroads.

b. Unless otherwise indicated, excluding apprentices, engineers, and technicians.

c. Weighted average of the three sectors of wood and allied products industry.

d. Based on the increase in productivity in the textile sector.

e. Estimated.

f. Weighted average of the increase in production of iron and steel products.

g. Centralized electric power only. Excluding distribution.

h. Production and refining only.

i. Residual.

j. Believed to include apprentices, engineers, and technicians.

k. Operating employees only.

l. Based on anticipated revenue.

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I. Metal Working and Machine Building Industry

1. Introduction

The Soviet machine building industry produces the machinery, equipment, precision instruments, weapons, metal goods, consumer durable goods, and transportation equipment needed by the economy. In 1958 the industry employed 4.9 million wage workers, or 30 percent of the total industrial labor force.* Approximately one-half of the workers in this industry perform manual production operations or do work of a low degree of mechanization -- as is especially true of assembly work, painting, and auxiliary operations such as internal plant transport.

According to the original plans for 1965, production of this industry is to increase 88 percent above that of 1958 and labor productivity 70 percent. Capital investment was originally planned to be 11.8 billion rubles** during 1959-65, or 11 percent of total investment in industry. According to newly revised plans, production is to reach a level of 120 to 124 percent above that of 1958, and labor productivity is to increase by 81 percent. Revised capital investment plans have not been announced, but investment during 1959-61 exceeded the plan. Soviet planners expect that about 35 to 40 percent of the increase in labor productivity will result from the introduction of more equipment and improved technology. They also place heavy emphasis on improved organization of the industry and improved utilization of labor.

Immediate Soviet plans for technical advances in machine building emphasize the following lines of attack: (a) more extensive use of automatic equipment and transfer lines*** in those parts of the industry that are concerned with mass production; (b) a systematic effort to increase the share of the total output that is mass-produced (about 30 percent); (c) mechanization of labor-intensive operations -- especially in assembly work, small-scale production, and auxiliary operations; and (d) applications of new technologies to reduce machining time and metal inputs. According to plans, applications of automation

* Excluding apprentices, engineers, and technicians.

** Ruble values throughout this report are in constant new rubles (based on the Soviet currency reform of 1961). New rubles may be converted to US dollars at the approximate rate of exchange for investment goods of 0.4 ruble to US \$1. This rate does not necessarily reflect the value of the ruble in terms of the dollar.

*** For brief definitions of Soviet terminology relating to automation and mechanization, see the Appendix.

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will be strongly concentrated in 26 plants specially designated to utilize and display applications of the latest achievements in integrated mechanization and automated operations. These applications will assume greatest importance in the four industries that are planned to have about 88 percent of the park of automated metalworking transfer lines in 1965 -- the industries producing motor vehicles, bearings, tractors, and agricultural machinery.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

For the parts of the industry that have large production runs, it is the Soviet intention to use more processing equipment incorporating significant elements of automation, such as the automatic feeding of work pieces and the automatic control of process variables. In addition to the automation of individual pieces of equipment, significant advantages in productivity are planned to accrue from linking lines of automatic machinery with transfer equipment, bunkering, and adding devices for the synchronization of operations and for the central control of line operation. In Soviet terminology, such lines of automatic machinery may be "automatic" or "semiautomatic" according to the degree of worker intervention required in the production operations. For the parts of the industry with smaller production runs, it is planned to produce about 1,300 machine tools with programmed control.

Production of automatic equipment planned for 1965 is most significant for the following categories of equipment, as shown in Table 2*: forge-press, welding, heat-treating, and galvanizing. Even in these categories, more than one-half of the equipment will be nonautomatic, and more than three-fourths of production of metalcutting machine tools also will be nonautomatic. Successful reorganization of the industry may permit longer production runs in more of the machine building industry and thus warrant a larger proportion of automatic equipment at some future time. In some types of operation, such as assembly, engineering problems remain to be solved before more extensive use can be made of automation.

Soviet plans stress the desirability of using automatic transfer lines of metalcutting tools. Some existing metalcutting equipment may be utilized for automatic and semiautomatic transfer lines, although not all existing equipment would be adaptable. During 1959-65 it is planned that 1,700 lines will be formed by adapting existing equipment and that 1,300 lines will be manufactured for use in machine building enterprises. Although these plans are ambitious when compared with the 1958 park of fewer than 300 automatic and

* Table 2 follows on p. 5.

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Table 2

USSR: Output of Automated Equipment in the Machine Building Industry
1958 and 1965 Plan

<u>Type of Equipment</u>	<u>Automated Units as a Percent of Total Units Produced</u>	<u>1958</u>	<u>1965 Plan</u>
Foundry		Negl.	15
Forge-press		10	40
Welding		15	40
Heat treating		10	45
Metalcutting machine tools		9	23 ^{a/}
Assembly work		4	25
Painting		5	30
Galvanizing		10	40
Storage and packing		2	25
Shop and intershop transport		3	15

a. This figure is higher than the 17 percent of production planned for 1965 as implied by earlier data; as later information it may reflect either a revised plan or a change in definition.

semiautomatic lines, fulfillment of the plans would represent only a beginning toward fulfillment of the scale of effort believed to be desirable. By the end of 1965 it is planned for all automatic and semiautomatic lines to utilize a total of approximately 40,000 metal-cutting machine tools, or less than one-seventh of the automatic and semiautomatic machine tools used by the machine building industry. These figures include lines and machine tools that have been modified to automatic functioning. In turn, the total park of automatic and semiautomatic tools in 1965 is planned to constitute only 15 percent of the metalcutting machine tools in the machine building industry. Present Soviet plans also stress the desirability of more automatic lines for forge-press operations.

Plans for 1980 are extremely ambitious. By that time, more than one-half of the annual output of metalcutting machine tools is planned to consist of automatic and semiautomatic units. Plans call for about 60,000 automatic lines to be in operation, including 6,000 foundry lines, 12,000 forge-press lines, and 40,000 lines for metalcutting and mechanical assembly. These plans assume that by 1980 approximately one-half of the gross output of machine building will be produced in plants with integrated automation.

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b. Mechanization

At present, about one-half of the 4.9 million workers in the Soviet machine building industry perform manual labor or use equipment of very low productivity. This extensive pool of manual labor is concentrated in the following types of work: the operation of non-automatic machinery requiring manual loading, positioning, adjusting settings, and receiving processed items; the manual assembly of the finished product; painting and finishing; packing and handling of materials; and maintenance and repair activities. Nonautomatic machine tools constitute more than 90 percent of the present park. Painting is rated as 3 to 10 percent mechanized; assembly work, 15 to 25 percent; and internal plant transport, 25 percent. A concerted effort is being made to reduce the importance of manual labor, and present plans expect that in 1965 the rated level of mechanization (including automation) in the industry will be 60 to 70 percent of full mechanization.

c. Modernization and Replacement

Plans for the modernization of the machine building industry are largely concerned with adapting machine tools wherever possible to automatic or semiautomatic operation and combining machine tools in automatic lines. In addition, some of the extensive park of machine tools that are more than 10 but less than 20 years old may be modernized to improve performance characteristics. According to the Seven Year Plan, the following quantities of machinery (including some employed in agriculture and in repair shops) will be modernized: at least 400,000 metalcutting tools, 57,000 forge-press machines, and 10,000 units of foundry equipment. The metalcutting tools represent nearly 25 percent of the 1958 park. It is planned that the expenditures on modernization will equal 30 to 50 percent of the cost of new equipment and will increase machine productivity by 20 to 25 percent.

Plans for the replacement of equipment are now extensive. In recent years the government has been moving from an annual replacement rate of 1 percent to a rate of 5 percent. For the economy as a whole, the Seven Year Plan calls for the retirement of about 600,000 machine tools, or approximately 30 percent of the park. In machine building and metalworking it has been announced that more than 350,000 pieces of obsolete machine tools and foundry machines are to be replaced by 210,000 pieces of modern equipment.

d. Introduction of New Processes

Technical progress in machine building is closely identified in the USSR with measures to establish economies of scale in production and to reduce requirements of processing time on articles

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being produced. To this end, efforts are being continued to reduce the number of components required in machine building, to standardize components, to make components interchangeable wherever possible between different machines, to develop group specifications so that slight variations may be handled by adjustments in automatic lines, and to establish specialized production facilities that can take advantage of economies of scale. Technological changes are oriented to the increasing use of such techniques as precision casting, simultaneous multiple operations that reduce the machine time per unit of output, new types of mechanical working such as electro-erosion and ultrasonics, and continuous flow production techniques. At the present time, specialization is proceeding slowly, with the greatest progress being made in the establishment of specialized plants to produce fittings, cutting tools, machine tools, automotive parts, and agricultural machinery.

3. Planned Gains in Labor Productivity

Assuming that the original planned production goals of the Soviet machine building industry are met, achievement of the labor productivity targets would represent a labor saving of more than 3.8 million wage workers by 1965 (although the total number of persons employed would grow). Revised production goals for 1965 and present consideration of plans to make more extensive use of multiple-shift operations in machine building plants may raise employment requirements in 1965, but present evidence indicates that the labor productivity goal also has been raised from a planned increase in productivity of 70 percent for 1965 above that of 1958 to a planned increase of 81 percent.

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II. Wood and Allied Products Industry

1. Introduction

The Soviet wood and allied products industry includes logging, sawmilling and woodworking, and the manufacture of pulp and paper. Employment of wage workers in this industry in 1958 totaled 2.3 million. Of this total, about 1.2 million were employed in logging, about 1 million in sawmilling and woodworking, and 0.1 million in the manufacture of pulp and paper.

Production in logging is scheduled to rise 15 to 17 percent during 1959-65; in sawmilling and woodworking, an estimated 100 percent; and in pulp and paper, an estimated 150 percent. The total planned capital investment is to amount to about 6 billion rubles during this period, 40 percent of which is earmarked for logging, 30 percent for sawmilling, and 30 percent for woodworking and the manufacture of pulp and paper.

The greatest technical advances during 1959-65 are planned for the pulp and paper and the sawmilling and woodworking sectors, with diminishing emphasis on development of the logging sector.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

Logging does not lend itself readily to the introduction of automatic equipment, but there are important potential applications in sawmilling and woodworking and in pulp and paper enterprises. In sawmilling and woodworking enterprises, some of the most important developments by 1965 are planned to be (1) the use of flow lines to do automatic planing work in an annual volume of 1.3 million cubic meters, (2) the automated production of 2.9 million cubic meters of pressboard, (3) the automated production of 269 million square meters of wood fiberboard, and (4) the introduction of automated and semiautomated lines for production of panel doors. In the pulp and paper enterprises, priority is to be given to integrated automation in selected enterprises. The Kamsk and Mariysk pulp and paper combines have been designated as model experimental enterprises for applications of integrated automation.

b. Mechanization

In the period following World War II, Soviet planners were greatly concerned with increasing labor productivity in logging and

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timber transport, and the investment program in these areas reflected this interest. As a result, the level of mechanization in logging rose sharply, and the use of seasonal labor was reduced to a relatively negligible level. Meanwhile, the development of mechanization in sawmills and woodworking enterprises suffered. It is estimated that at the present time 70 percent of the equipment in these enterprises is obsolete, being characterized by hand feeds and low cutting speeds. Plans for 1965 lay particular stress on the mechanization of storage operations in the yards, on the improvement of processing operations (materials feed, transport between operations, and positioning of material), and the development of techniques for handling bulk materials.

The operation of the pulp and paper enterprises is mechanized, with the exception of yard and transport work. About 30 percent of the wage workers in the pulp and paper industry are engaged in yard and transport operations, which are mechanized in about 35 to 40 percent of the volume of operations.

c. Modernization and Replacement

Modernization and some replacement of equipment in sawmills and woodworking enterprises will be required to reduce the present high ratio of obsolete equipment. A very important program is the planned modernization of papermaking machines. In recent years, 18 of these machines have been modernized profitably, and it is now planned to modernize the entire park for 1965. Approximately one-third of the planned growth of papermaking capacity is to result from the modernization of existing papermaking machinery.

3. Planned Gains in Labor Productivity

The Seven Year Plan calls for the following increases in labor productivity: logging, 53 percent; sawmilling and woodworking, 50 percent; and pulp and paper, 73 percent. On the assumption that planned production and productivity goals are reached, a labor saving of 1.2 million persons in 1965 is estimated. Apparently about 50 percent of this total labor saving will originate in the sawmilling and woodworking sector. According to Soviet estimates, achievement of labor productivity plans would permit a reduction of employment in the logging sector of 300,000 by 1965.

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III. Construction Materials Industry

1. Introduction

The Soviet construction materials industry produces cement, brick, precast concrete, rock products, and other materials used in construction but excludes such important construction materials as lumber, steel, and flat glass. In 1958 the industry employed 1.1 million wage workers at approximately 14,000 plants and quarries. The gross output in 1965 is planned to be 2.5 times the level of 1958, and the total planned capital investment during 1959-65 to achieve this increase is 7.7 billion to 7.8 billion rubles.

Few data are available on over-all Soviet plans for technical advances in the construction materials industry, except for some data on the cement industry. This scarcity of information is due in part to the widespread and highly decentralized nature of the industry. The cement industry, however, has fewer than 100 plants and, although it employs a minor share of the wage workers in the construction materials industry (4.8 percent in 1958), is of major concern to the central planners because of its importance to the over-all construction effort and because cement is in short supply. Initially the cement industry was to receive approximately 18 percent of the capital investment planned for the construction materials industry, or 1.4 billion rubles during the Seven Year Plan. Subsequently the investment plan for the cement industry was raised so that during the last 5 years of the 7-year period a total of 1.35 billion rubles was to be expended.

2. Programs for Technical Advances

The primary means of achieving technical advances in the cement industry is by installing new, more highly productive equipment (particularly kilns and grinders) at existing plants and by constructing very large new plants. The total addition to capacity for 1961-65 is planned to be 49.4 million tons* at 26 new plants and 45 expanded or reconstructed plants at which 109 new production lines (kilns and ancillary equipment) are to be added. As a result of the planned programs (including larger equipment, increased mechanization, modernization, and automation), the average hourly productivity per rotary kiln is to increase by 1965 to 60 percent above the level of 1960; the prime costs of production are to be decreased by at least 20 percent; capital expenditures per ton of added capacity are to decrease; and labor productivity is to increase by 85 percent compared with that of 1958. In addition, operating economies and increased kiln efficiencies are expected

* Tonnages are given in metric tons throughout this report.

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to result from the substitution of natural gas for coal as fuel. Soviet sources estimate that this shift in fuels will permit an increase in production of cement of 4.5 million tons, without additional capital investment.

Soviet designers are working on the design of a fully automated cement plant, and present plans call for serial production of new instruments for automatic control of the processes in the manufacture of cement, including closed circuit television, programmed control of the preparation of slurry and the drying of admixtures, the automated operation of rotary kilns, and the operation of electric filters in conjunction with gas analyzers. Soviet designers estimate that integrated automation at 20 existing plants will cost 6 million rubles and increase output of cement by 600,000 tons.

Plans for technical advances in other segments of the construction materials industry include continuous production of asbestos cement sheets, an automated brick plant and a ceramic tile line, and mechanized flow production of a number of other materials.

3. Planned Gains in Labor Productivity

In spite of the vagueness of the plans for technical advances in the construction materials industry, the resultant planned increases in labor productivity can be estimated. In 1958 the industry employed 1.1 million wage workers. By 1965, production is to increase by 150 percent above the level of 1958. On the assumption of an increase in labor productivity of about 60 percent,* the implied reduction of requirements for wage workers in 1965 would be approximately 1 million persons, and the increase in employment thus would be only about 0.6 million persons. Because wages account for a large share of costs in the construction materials industry, the reduction in wages per unit of output is a significant factor in the planned reduction of production costs of about 30 percent.** Increases in the productivity of labor in the cement industry are of minor significance to the construction materials industry as a whole because of the very small share of the total labor force employed in production of cement.

* Based on a preliminary plan for the RSFSR of a 63-percent increase.
** Based on a plan for the RSFSR of a 32-percent reduction.

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IV. Light Industry

1. Introduction

Soviet light industry consists of the manufacture of textiles, clothing (knitwear and hosiery), and footwear. Excluding those employees who are members of industrial cooperatives, employment of wage workers in light industry in 1958 amounted to almost 15 percent of the total industrial employment -- or about 2.5 million persons, 73 percent of which were women. Including employees who were members of cooperatives, the total employment was about 3.1 million. Slightly fewer than 1 million of this total were employed in the manufacture of textiles, about 1.3 million in the manufacture of clothing, and about 0.8 million in the manufacture of footwear.

The total production of light industry is scheduled to rise about 50 percent during the Seven Year Plan, and capital investment in the industry is to amount to about 3.3 billion rubles. Late in 1960 and early in 1961 these figures probably were revised upward by an indeterminate amount.

Of the various components of light industry, the plan is for the manufacture of textiles to receive the largest share of capital investment -- 2.6 billion rubles, or 79 percent of the total allocated to light industry. During the plan period, output of textiles is scheduled to rise 78 percent, and productivity of labor is scheduled to grow 36 percent. The use of new equipment and improved technology is to account for one-half of the increased productivity.

Soviet plans for technical advances in light industry have concentrated the greatest attention on the manufacture of textiles. Although the textile industry relies heavily on mechanized processes such as weaving, spinning, and finishing fabric, it employs a large number of wage workers, predominantly women. Because there is a relatively large number of women on the labor market, there may be some tendency to move slowly in the direction of substituting capital equipment for human labor. On the other hand, forms of mechanization were to be introduced during the plan period to improve general working conditions, to permit reductions in the work hours, and to eliminate unsuitable heavy manual labor -- thus facilitating the employment of women. In order to achieve the desired increases in production of textiles, the Seven Year Plan calls for the introduction of automatic equipment, the mechanization of tasks previously done by hand, the modernization of obsolete equipment, and the introduction of new processes.

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2. Programs for Technical Advances

a. Introduction of Automatic Equipment

The Soviet textile industry produces a wide range of intermediate products and final goods using a wide assortment of production operations, some of which are automated, most of which are mechanized, and a few of which are done manually. In preparing cotton for spinning, 67 percent is prepared by automatic processes, and 39 percent of the yarn is knotted automatically. In sizing cotton, 80 percent of the equipment that is used has controls to regulate the temperature, the level of the sizing, and the steam pressure. In spite of such applications of partial automation, Soviet writers have stated that the uses of automation in the textile industry lag behind those of other advanced countries. They particularly note that the USSR is laggard in the use of automatic yarn rewinding; of air-conditioning in plants; of automated intraplant transport; and automation in the processes of bleaching, dyeing, and finishing fabrics.

The Seven Year Plan calls for the rapid introduction of automatic looms, yarn rewinders and knotters, hosiery-making machinery, units for unwinding cocoons, and air-conditioning equipment. These items, however, represent the application of technology or automation on a partial basis, not on the basis of the introduction of fully automated textile plants.

As of the beginning of the Seven Year Plan, 44 percent of the weaving was done by automatic looms. Priority in the plan is given to the replacement of the nonautomatic units, with the following planned changes in the percentage of the total weaving to be processed by automatic looms: in cotton weaving the share is to rise from 45 percent in 1958 to 75 percent in 1965; in linen, from 32 to 96 percent; and in wool, from 24 to 69 percent. In the cotton industry alone, 110,000 automatic looms are scheduled to be installed, 27,000 of which will be for replacement purposes.

b. Mechanization

Although the main emphasis in the development of light industry, and especially of the textile industry, is being placed on the use of machinery that is more productive, there are many types of activity in which hand labor is to be replaced by machinery. Manual labor is extensively used in feeding and unloading machinery, in transporting material, and in cleaning machinery and work areas. Thus more workers are employed as receivers for taking cops of yarn from spinning machines than are employed as spinning operators, and most of the transportation work in the plants and shops is done with the use of hand carts (there are 120,000 such hand carts in the textile industry of the RSFSR).

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The Seven Year Plan calls for equipping the textile industry with transport mechanisms and systems, with attachments for receiving machine output mechanically, and with pneumatic devices for cleaning machinery and work areas as well as with other devices for replacing hand labor.

c. Modernization and Replacement

Many of the facilities of the textile industry are equipped with obsolete machinery. In the cotton textile industry, almost all of certain classes of equipment is more than 20 years old. The effectiveness of modernization of the spinning machines has already been demonstrated in some plants, and an extensive program is underway. The result of modernization in the textile industry during the Seven Year Plan has been expressed in terms of a planned additional output of 226 million linear meters of cloth from existing weaving plants, or about 10 percent of the total planned increase. Of this total, 202 million linear meters represent cotton cloth, or 12 percent of the planned increase for cotton. A sizable share of the new automatic looms is being designated for replacement purposes (especially new cotton looms, 25 percent of which are to be replacements).

d. Introduction of New Processes

The basic production processes of the textile industry are well-established, and the direction of change is toward increased efficiency of operation through higher machine speeds and improved control of process variables. In addition, there is heightened emphasis on control of the quality of the final product. Work also is being done toward improving the organization of operations. Thus spinning is being made a continuous flow process, whereas it now consists of six separate operations. If this improvement is achieved, there could be a possible gain of 90 percent in labor productivity. Finishing operations also are being made into a continuous flow process, thus eliminating manual transfer between intermediate operations.

3. Planned Gains in Labor Productivity

Assuming that planned production goals of the textile industry are met, achievement of the labor productivity targets would represent a labor saving of more than 400,000 persons by 1965 (although the total number of persons employed would grow). Of this saving, nearly one-half could be attributed to the use of new equipment and of improved technology. Because of the absence of pertinent data concerning the manufacture of clothing and footwear, the total labor savings in all of light industry cannot be calculated, but rough estimates can be made by making assumptions of the possible magnitude. If it is assumed that the

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gain in labor productivity for all of light industry is not more rapid than that for the textile industry, the savings would be slightly less than 1 million wage workers.

V. Food-Processing Industry

1. Introduction

The Soviet food-processing industry is concerned primarily with processing meat, fish, dairy products, and sugar; with canning food; and with baking bread. It employed about 1.6 million wage workers in 1958. The present level of labor productivity in the food industries is generally rather low, mechanization is incomplete, and the use of automatic equipment is very limited. Under the Seven Year Plan, productivity of labor is to be increased 50 percent while holding the gain in employment to approximately 15 percent.

The gross output of the food-processing industry is scheduled to rise more than 72 percent during the plan period, and capital investment in the industry is to amount to at least 4.7 to 5.3 billion rubles. These figures were recently revised upward by an indeterminate amount. During the plan period, 80 percent of the capital investment in the food industries will be concentrated in four branches: the meat, dairy, sugar, and fishing industries.

Soviet plans for technical advances in the food-processing industry emphasize primarily increased mechanization and improved organization of production flows. The uses of automation that are planned at present are limited to particular operations, such as packing, temperature control in processing, and measuring and weighing.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

Plans call for the introduction of automatic equipment in only a few branches of the Soviet food-processing industry. During the plan period, technical advances in the dairy industry are being emphasized, with particular attention to increased use of automatic pasteurization, automated production of condensed milk, automatic drying of milk, and automatic bottling or packaging units. In the processing of sugar beets, individual production operations, although not necessarily all operations in any given plant, will be automated in 109 plants, and 60 production lines with integrated automation will be installed by 1965. Some increase in the use of automatic equipment in the meat industry is planned, but information is limited to a few meat products.

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b. Mechanization

Previous to the Seven Year Plan a low priority had prevailed for the supply of equipment to the meat-processing industry. It is planned that this situation be remedied during the plan period, and, through the replacement of hand labor by machinery, much of the heavy and unpleasant work in the industry is to be eliminated. The Seven Year Plan calls for the following changes in the percentage of meat processed from livestock that is to be mechanized: for cattle the share is to rise from 42 percent in 1958 to 80 percent in 1965; for sheep and goats, from 41 percent to 80 percent; and for swine, from 25 to 90 percent.

Although much had been done during 1955-59 toward the mechanization of centers for the distribution of milk, Soviet planners stress the need for further work. Receiving points for milk are characterized by the extensive use of hand labor. In the RSFSR, 34 percent of the dairy enterprises are basically nonmechanized. More than 70 percent of the city milk plants do not have mechanized flow lines or automatic units, and in them the work of packaging and handling milk products is done manually. Only 18 percent of production of butter comes from fully mechanized flow lines, and in production of cheese such basic operations as framing, pressing, and commodity handling are done manually.

During 1959-65, plans call for significant changes in this situation. Equipment to be installed includes 700 mechanized flow lines in the RSFSR and, in the USSR as a whole, 200 units to manufacture and fill paper milk containers; 80 flow lines for the production of dried milk; and 706 flow lines for producing butter (which will bring the total to 1,200 flow lines in the USSR). Mechanization of production of cheese will double output from existing facilities.

The beet sugar industry employs more than 120,000 workers in loading and handling materials. The unloading of freight carriers is mechanized about 55 percent, whereas stacking and storage work are mechanized only 40 percent. At present, not one plant has mechanized fully its production processes. Extensive changes have been planned for this industry, as indicated by data now available for the RSFSR. By 1965, 80 percent of the sugar is planned to be processed and packaged in mechanized lines, including some automation. In 1958, only 4 percent of production came from such lines. Equipment is to be supplied to permit substantial replacement of hand labor in loading, stacking, and handling materials, freeing -- in the RSFSR alone -- some 30,000 employees now performing this type of work.

The Soviet fishing industry has become very productive in terms of the fish catch but not in terms of the manpower required in processing the catch. Most of the work of cleaning, curing, transporting, and storage handling is done manually. Even in the new seagoing

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trawlers (BMRT), which feature a relatively high degree of mechanization, the work of cleaning fish is done manually. Only 20 to 40 percent of the operations performed in canning fish are mechanized.

By 1965 it is expected that 50 percent of the fish catch by the RSFSR fishing fleet will come from the new BMRT trawlers. In addition, 137 mechanized production lines for canning fish and additional lines for processing fish products including fish meal are to be introduced in the RSFSR.

The technical level of food canning is quite low in the USSR. Most operations involving the handling of materials, the loading and unloading of autoclaves, and the preparatory cleaning of raw food materials (onions, potatoes, and fruits) are done manually. The Seven Year Plan calls for a modest improvement of this situation, freeing some workers from the more labor-intensive processes of loading, cleaning, and handling containers. In the RSFSR, 340 mechanized canning lines are planned to be put into operation.

A few bakeries in Moscow and Leningrad are now highly mechanized, incorporating programmed production in some phases of the baking operation. The Seven Year Plan calls for a countrywide introduction of the mechanized bakery.

c. Introduction of New Processes

Soviet plans stress raising the level of technology in the food-processing industry to levels now found in advanced countries. An effort is to be made to establish flows of operations so that something like continuous processing can evolve, reducing in importance costly batch processes. There also are to be changes in the nature of packaging, such as the increased use of paper cartons and metal cans.

3. Planned Gains in Labor Productivity

The productivity of labor in the industry is planned to increase approximately 50 percent during 1959-65, and output is planned to increase 72 percent. If productivity and output goals are achieved, there will be a net gain in employment of approximately 240,000. If there were no increase in productivity, 940,000 additional wage workers would be required to achieve the planned production for 1965. Of the total labor saved, somewhat more than one-half would be attributable to the effects of the introduction of integrated mechanization and the applications of automation.

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VI. Chemical Industry

1. Introduction

The Soviet chemical industry is concerned primarily with the mining of chemical raw materials (potassium, apatite, and the like), production of basic inorganic chemicals (acids, alkalis, fertilizers) and organic products (rubber, fibers, plastics, dyes), and the fabrication of rubber and asbestos articles. The estimated employment in the chemical industry in 1958 was about 0.7 million workers. In 1957 the organic products segment of the industry employed 35 percent of the total number of wage workers in the chemical industry; the basic chemicals and mining segments, 24 percent; and the rubber and asbestos segment, 20 percent. The share of the chemical industry in the total industrial fixed assets early in 1960 amounted to 4.9 percent.

Production of the chemical industry is scheduled to triple during the Seven Year Plan, and capital investment is to amount to 10 billion to 10.5 billion rubles, or about 10 percent of the total Soviet industrial investment. Somewhat more than 3 billion rubles are to be allocated for equipment, and nearly one-third of this sum is to be for chemical processing equipment. About 75 percent of the total investment in the chemical industry is to be allocated during this period to branches producing synthetic materials (rubber, fibers, plastics) and fertilizers.

The Soviet chemical industry is characterized by the use of large amounts of manual labor and outmoded batch processes. Present Soviet plans call for the widespread introduction of highly productive equipment and advanced processes, both to facilitate fulfillment of the ambitious production goals with minimum inputs of labor and to effect a radical improvement in the quality of chemical products. Mechanization is to be stressed in the mining of chemical raw materials and in plant operations involving the handling of large amounts of bulky raw and finished materials. In addition, the industry is scheduled to effect a radical shift to the use of petrochemical raw materials and to improve the design of new chemical facilities in order to achieve savings in capital investment and to utilize byproducts more effectively.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

Soviet plans for the introduction of automatic equipment in the chemical industry have been published only in sketchy and ambiguous outline. Thus it is stated that it is planned to "automate" more than 150 shops and production processes of various plants of the industry.

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The definition of automation is not given, but the term probably is used in the sense of "integrated automation," which embraces the activities of the entire shop or process. The information on the products most likely to be affected by this type of integration is somewhat better. Most attention is to be paid to automating production of synthetic materials (rubber, fibers, plastics), their products (tires, plastic articles, and the like), fertilizers, alkali products, dyes, and alcohol.

Information as to the degree of automation is ambiguous, but investment data provide a clue. Of the 10 billion to 10.5 billion rubles that are to be invested in the industry during 1959-65, it is estimated that about 0.2 billion to 0.4 billion are to be spent for automation. Because the indicated share is only 2 to 4 percent of the total investment, it would seem that investment in automation is defined to consist of investment in the means of automation, consisting largely of instrumentation, control equipment, and various regulating devices. As noted in one Soviet article, even in new chemical plants, expenditures on automation do not exceed 1 to 3 percent of the total cost of equipment, and only in organic synthesis plants do these expenditures ever achieve as much as 8 to 10 percent.

Soviet sources state that, by the end of 1965, production of synthetic rubber and synthetic alcohol will be fully automated, that production of plastics will be 95 percent automated, and that production of synthetic fibers will be 90 percent automated. The measure of automation used here appears to be the share of production processes that are automated -- "full automation" in this sense means that all of the processes are automated but does not mean that all production comes from fully integrated automatic plants.

Although there is stress on automating shops and processes, comparatively few plants have been designated for complete automation. References have been made to the establishment of model automated plants at Voronezh, Lisichansk, and Novomoskovsk (formerly Stalinogorsk). Alcohol plants at Orsk, Ufa, Kuybyshev, and Saratov are to be modeled after the Sumgait plant.

In contrast to the US, where automation is applied extensively in the chemical industry, the present status of automation in the Soviet chemical industry is characterized by a great deal of partial automation that is neither as coordinated nor as productive as it should be. Part of the blame is attributed by Soviet experts to the inadequate variety and quality of instruments being produced, to inadequate process design work, and to the fact that much of the present equipment is not particularly adaptable to automation. The new plans for automation have been made on the basis of priority being assigned to developmental work on those chemical processes that are most labor-intensive.

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Soviet writers have not commented on the expected effect of implementation of the automation program in terms of the entire industry. They have given some partial data that appear to apply only to the effect of automation on those parts of the industry that are automated. Thus it is stated that automation will increase output by 5 to 8 percent, increase the productivity of labor by at least 30 percent, lower the cost of production by 10 to 15 percent, and decrease the number of service personnel by 15 to 20 percent. The labor-saving effect is noteworthy and is consistent with the priority given to automating labor-intensive processes.

b. Mechanization

The level of mechanization in the Soviet chemical industry is extremely low, and great savings in cost and manpower are possible if operations such as loading and unloading, charging of raw materials into process equipment, and weighing and packaging of materials are mechanized. About 40 percent of the total number of wage workers employed in production of chemicals perform manual labor, including about 15 percent of the total force who are engaged in handling materials. Soviet planners expect that fulfillment of the mechanization plans will permit the freeing of 100,000 workers. Details have not been published on the total investment in mechanization.

c. Modernization and Replacement

Growth in the chemical industry is characterized by reliance on new production facilities to a greater extent than in other industries. Enterprises being constructed number 140, and those being reconstructed number 130. Because obsolescence is so rapid in this industry, it must be assumed that there will be extensive replacement of equipment in plants being reconstructed.

d. Introduction of New Processes

The Seven Year Plan emphasizes the development and introduction of new products that require the use of new processes, new intermediate materials, and new sources of basic materials. Development of the chemical industry, therefore, is highly unpredictable, especially in the realm of organic intermediate materials. Nevertheless, some of the broad outlines of development have been depicted by Soviet planners.

Many of the new chemical processes planned for introduction during 1959-65 involve the processing of petrochemical raw and intermediate materials. The plan calls for the chemical industry to use natural gas extensively. In 1965 the industry is to use 2.5 million tons of liquid hydrocarbons derived from gas. Major products to be

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produced from petrochemical feed materials include synthetic rubber, ammonia, acetylene, detergents, plastics, and fibers. It is important to note that this entire field was not highly developed in the USSR previous to the Seven Year Plan and that in large part its development will involve the applications of technologies relatively new to the Soviet engineers. In addition to the native efforts to develop new technology, a sizable volume of technical process data relating to production of fibers, plastics, motor vehicle tires, and other chemical products was purchased from the Free World during 1958-61.

Because production is scheduled to increase at a very high rate, more than 15 percent per year, the USSR plans to undertake measures designed to increase production efficiency and to reduce cost. It plans to take advantage of larger production runs from more productive units to gain economies of scale, thus spreading overhead costs and capital costs over a greater volume of output and permitting process changes away from batch processing and toward flow processing. This line of development will involve specialization of production, concentrating production at a few major units that can thus produce in greater volume; some changes in the basic design of production processes; and greater effort to increase the utilization of waste and byproduct materials.

3. Planned Gains in Labor Productivity

No target on labor productivity is available for the chemical industry, but it appears probable that the increase of productivity is intended to be more than the 45 to 50 percent planned for industry as a whole. If it is assumed to be at least 50 percent, it is possible to indicate the labor saving necessary in the plans for the industry. The number of wage workers in the chemical industry in 1958 has been estimated to be 700,000. If output is to triple and productivity is to increase 50 percent, the implicit labor saving from all causes would be 700,000 by 1965.

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VII. Ferrous Metallurgical Industry

1. Introduction

The Soviet ferrous metallurgical industry is an integrated industry that performs the operations of the metallurgical cycle from the mining of ore and other raw materials through the smelting of metal and the rolling and finishing of steel. In 1958 the industry employed about 607,000 wage workers,* and about 200,000 of these were in basic production operations, 150,000 in transporting and handling materials, and 180,000 in repair and maintenance activities.

During 1959-65, production of crude steel is planned to increase 75 percent to 96.0 million tons and rolled steel to increase by 70 percent to 73.6 million tons. Capital investment in the industry for this period probably will exceed 10 billion rubles, approximately one-third of which are to be devoted to the development of facilities for mining and ore-preparation. About 370 million rubles have been allocated for mechanization and automation.

Soviet plans for technical advances during the plan period are directed essentially to the extensive application or further development of known techniques that also are being adopted increasingly in steel industries in Western countries. Attention is to be concentrated on improvements in the beneficiation of ore, the increased use of auxiliary fuel injection and other practices in blast furnaces, the use of oxygen in blast furnaces and particularly in steelmaking, the further development of continuous casting capacity, the construction and installation of high-capacity production units embodying advanced design and technology, and increased mechanization and automation in all segments of the industry.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

According to Soviet plans, the "level of mechanization and automation" of the Soviet ferrous metallurgical industry is to be raised to 80 percent** during the Seven Year Plan. About 250 projects of the iron

* If wage workers in ferrous mining and coke chemicals are included, employment in the industry is 678,000 workers.

** The statistical basis of this figure has not been defined. In many cases in Soviet practice it applies to the percentage of the labor force directing the operation of machines; by implication, then, 20 percent of the labor force would be involved in manual work related to the handling of materials, the repair and servicing of machinery, and other manual work.

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ore industry, 114 blast furnaces, 177 open-hearth furnaces, and 45 rolling mills are to be automated.* Although the degree of automation has not been defined, it would appear, in most cases, to mean partial automation -- that is, automation of one or more operations of a mine, furnace, or mill rather than automation of the entire producing unit. More complex automation will be undertaken at six plants that are to become models for mechanization and automation -- the steel plants at Kuznetsk, Magnitogorsk, Nizhniy Tagil, and Dneprodzerzhinsk, the Bagley coke-chemical plant, and the Zaporozh'ye refractories plant.

Although the Soviet claim is that 90 percent of Soviet iron and steel is produced in "automated" furnaces, the statement refers to production in furnaces on which some specific operations are automatically controlled, not to completely automated furnaces. Reportedly, all blast furnaces are partially automated in that they are equipped with devices for automatic charging and for regulating the temperature of the hot air blast -- 90 percent of Soviet blast furnaces are said to be supplied with automatic moisture-regulating equipment and 67 percent with devices for regulating gas pressure. In steelmaking, instruments and devices for automatically measuring and controlling the intake of fuel, air, and oxygen and for measuring and recording pressure and temperature have been developed and applied to varying degrees. Experimental work has been undertaken on the application of computers to controlling steelmaking units, and in 1960 at least part of the operations of a Bessemer furnace at the Dneprodzerzhinsk metallurgical plant was controlled automatically by means of a computer installed at Kiev, 500 kilometers from the steel plant.

In the automation of rolling mills and finishing line equipment, efforts are being directed to the installation of modern continuous rolling mills and heat-treating and coating lines, which in the West incorporate devices for automatically controlling the quality, dimensions, and finish of the product. Such devices presumably are being incorporated in the new, modern Soviet mills being installed during 1959-65. In general, however, automation of rolling and finishing facilities has progressed inadequately, according to Soviet evaluations. In these facilities, even available technology has not been applied to the same degree as in blast furnaces and open-hearth furnaces. Present plans are to have in operation by the end of the plan period 82 large, continuous rolling mills embodying extensive application of automatic control and regulation devices.

* These figures may include some projects of the nonferrous metallurgical industry.

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b. Mechanization

One of the basic problems affecting Soviet progress toward a high degree of automation of the ferrous metallurgical industry is the very limited degree to which it is presently mechanized. Present plans provide for the extensive mechanization of operations in all segments of ferrous metallurgy. Immediate plans include a wide range of standard measures such as the use of larger capacity cranes, forklift trucks, and conveyors as well as more complex measures such as the installation of automated conveyors for charging blast furnaces and open-hearth furnaces. Long-range plans envisage integrated automation and the mechanization of handling materials and plant transport, including the introduction of such measures as the use of automated conveyors for charging furnaces, the hydraulic removal of granulated slag, and the removal of pig iron by induction pump. Such systems, however, are not anticipated during the current Seven Year Plan.

c. Modernization and Replacement

About 67 percent of investment funds allotted to the ferrous metallurgical industry for 1959-65 are to be directed toward the expansion and reconstruction of existing enterprises. The modernization will occur in the form of the addition of instrumentation and of control devices to existing facilities, increased mechanization of auxiliary operations, reconstruction of production facilities to new operating parameters, and the introduction of improved practices at existing plants. Retirement of obsolete facilities planned for 1959-65 include 21 blast furnaces with a total capacity of about 4 million tons, 44 open-hearth furnaces with a total capacity of 2.2 million tons, and 91 rolling mills with a total capacity of about 3 million tons.

d. Introduction of New Processes

Major benefits in the form of increased rates of production, reduced costs of production, and savings in capital investment are implicit in Soviet plans for applying more extensively a relatively few technical developments. The plan provides for improvement in methods of concentrating ore, the increased use of sinter (from 75 percent of the blast furnace charge in 1958 to 90 percent in 1965), and the construction of some pelletizing facilities. Fifty blast furnaces are to be equipped for the use of natural gas as a fuel. In 1965, oxygen is planned to be used in production of about 70 percent of the output of steel for the year compared with 24 percent in 1958. Most of the output will be from oxygen-fed open-hearth furnaces. Considerable difficulty is being experienced in developing basic oxygen converters.

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The Soviet industry has made much of the development of continuous casting facilities for nearly a decade, with industrial-scale equipment already installed in six plants and with five more installations planned for 1959-65. Although the casting of at least 8 million tons of steel in such facilities is planned for 1965, the advantages to be derived from the process on a tonnage basis remain to be demonstrated both in the USSR and in the West.

Probably the most impressive gains during the Seven Year Plan will arise from the extent to which the Soviet steel industry is equipped with modern equipment for rolling and finishing steel and with efficient facilities for handling materials. There is no indication that any such facilities involve technology that is new to the West.

3. Planned Gains in Labor Productivity

The implicit labor saving of plans for technical advances in ferrous metallurgy is approximately 300,000 wage workers* by 1965. Of the total labor saving, about 50,000 will be attributable to the advances in automation and in integrated mechanization. Much of the remainder will stem from such other measures as the simple replacement of men by machinery (as in the handling of materials), gains in productivity of machinery through improved design and instrumentation, and organizational measures.

* If wage workers in ferrous mining and coke chemicals are included, the implied labor saving would amount to about 340,000 workers by 1965.

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VIII. Nonferrous Metallurgical Industry

1. Introduction

The Soviet nonferrous metallurgical industry includes the mining and processing of base metals, noble metals, ferroalloying metals and minerals, rare metals and earths, and a variety of nonmetallic elements. With the exception of nickel and such nonmetallic elements as asbestos and salt, the base metals, which include copper, lead, zinc, aluminum, tin, titanium, and magnesium, account for the major share of the gross output of the industry.

The Seven Year Plan calls for investment in the industry of about 5.5 billion rubles. About 60 percent of all capital outlays are to be expended on the aluminum, nickel, and copper segments of the industry, and about two-thirds of all capital outlays are to be expended on the mining sector. A large part of this investment is to be devoted to enlarging and modernizing existing mines and ore-processing plants.

Although Soviet engineers appear to have been familiar with the most advanced technology for ore and metal processing, and to have been thoroughly aware of the shortcomings within existing plants, the industry has been slow to adopt new methods. A gradual improvement in this regard has been noted in the last few years, however, and at the present time the USSR probably can extract the principal metals from intermediate products about as efficiently as can Western industrial countries. The USSR continues to lag behind the West, however, in mining, in concentrating ores, and in the extraction of many byproduct minerals. The concentration of investment on mining and the processing of ores is designed to help correct these deficiencies.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment and Mechanization

Automation and integrated mechanization of various processes have been planned at all stages of ore and metal processing in the industry. The automation proposed does not take the form of plant-wide automation but rather the automation of the control and regulation of various operations in individual production processes. In nonferrous shaft mines, for example, equipment for water drainage, ventilation, heating, lifting and loading, and transportation are being automated to a greater extent than in the past, and a corresponding reduction in the labor force is being made.

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The principal goal of the Seven Year Plan for the mining sector of the Soviet nonferrous metallurgical industry is to increase production and to reduce unit costs. This goal is to be accomplished by enlarging existing mines, by introducing more efficient methods of mining, by increasing mechanization of all operations, and by introducing better mining equipment to replace obsolescent equipment.

In order to increase the rate of recovery from ores to concentrates, bulk-selective flotation is being introduced in many plants that process polymetallic ores. This method will result in a growth in productivity in some ore-dressing plants of 10 to 20 percent. The USSR is further improving the performance of its concentration plants by introducing high-speed flotation machines, multistage concentration tables, high-speed inertia crushers, screw separators, and centrifugal mills.

Many Soviet metallurgical plants are relatively inefficient by Western standards, but improved techniques and equipment are being adopted and installed. Two processes that are to be introduced on a wider scale and that are expected to result in a significant saving of copper, lead, and zinc during the 7-year period are (1) the use of oxygen and preheated air in smelting, which is expected to increase productivity of reverberatory furnaces by 20 percent and to reduce the outlay of coke by 10 percent, and (2) the electrothermic method of smelting. Efforts to reduce losses still further will be made by introducing additional slag-fuming facilities and by establishing installations for collecting and processing dust and flue gases in the copper plants of the Urals and in the lead-zinc enterprises of Kazakh SSR. The wider use of these techniques for recovering metals lost in processing is expected to yield several hundred thousand tons of nonferrous metals during the plan period and will result in sizable increments to output at lower capital costs per ton than would be obtained by constructing new facilities.

3. Planned Gains in Labor Productivity

The Seven Year Plan provides for an increase in the gross output of the nonferrous metals and minerals industry of about 100 percent and an increase in labor productivity of 80 percent. Although gains in productivity cannot be translated readily into quantitative terms, these goals suggest that output will be doubled while the labor force will be increased only about 11 percent.

Much of the increase in labor productivity planned for the industry probably will be realized in the mining sector. An increase in the proportion of open-pit mining (a considerably less labor-intensive method of mining than shaft mining) from 48 percent to 65 percent of the total ore extracted probably will account for a major part of the

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planned increase in labor productivity in the industry. Greater automation and mechanization in both open-pit and shaft mining may increase labor productivity still further. Gains in this sector could be large enough to ensure that the 77-percent increase in the extraction of non-ferrous ores planned for 1965 will be achieved with a smaller labor force than was employed in this type of mining in 1958.

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IX. Coal Industry

1. Introduction

The Soviet coal industry consists of all coal mining activity (open-pit and underground) and all preliminary processing activities such as briquetting, screening, and cleaning. When the mining and processing activities are conducted at the same installation, as they frequently are, the related transportation activities also are included in the industry classification. In 1958, more than 1 million wage workers were employed in the coal industry, and roughly one-half of these were employed in basic production work. In comparison with all other domestic industries, the Soviet coal industry has the highest proportion of workers, about 45 percent, engaged in transporting and handling materials.

The Seven Year Plan for production of coal calls for a 23-percent increase above the level of output in 1958, with production of coal scheduled to reach 612 million tons in 1965.* Plans for capital investment stipulate an expenditure of 7.5 billion to 7.8 billion rubles for 1959-65, of which only about 30 percent (compared with more than 45 percent during 1952-58) is to be used to increase the rated capacity of mines. The Soviet coal investment program for 1959-65 focuses a great deal of attention on mechanization and the replacement of equipment, whereas the opening of new productive capacity will be somewhat offset by the retirement of old marginal producers. In the short run the effect of such an investment program would be to raise the average investment cost per ton of the coal mined, but in the long run the over-all effect of the continuation of such a program will be to reduce labor requirements, reduce costs, and improve the quality of coal.

The Soviet coal industry has been and continues to be plagued by high costs, poor quality, and overemployment in auxiliary and service activities. As a result, Soviet plans for technical advances in the coal industry strongly emphasize increased mechanization, especially in transporting and handling materials and in the cleaning of coal. Lack of adequate capacity for the cleaning of coal has retarded growth in the industry, especially in the diversification and expansion of consumption. Excess pithead stocks of uncleaned coal of poor quality in 1958 and 1959

* This goal is not expected to be achieved. According to present estimates, production of coal in 1965 probably will be only about 565 million tons.

attest to the need for additional cleaning facilities. In order to reduce both the cost of production of coal and the size of the labor force, the USSR plans to expand significantly strip and hydraulic mining and to introduce mechanization and, to some extent, automation on a greatly expanded scale.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment and Mechanization

Present Soviet long-term planning strongly emphasizes increasing the mechanization of the industry, especially in the auxiliary activities of transporting and handling materials, and introducing some partial automation in the form of automatic control devices and some remote control systems. This course of action is strongly influenced by the objectives of eliminating hard physical labor (presently done by 40 percent of the labor force) and reducing the total employment in the industry by 1965.

The Seven Year Plan calls for increasing the proportion of coal loaded by mechanical means from 40 percent in 1958 to 65 to 70 percent in 1965. Although the cutting of coal is almost completely mechanized, much of the work is still labor-intensive and is done by workers with pneumatic picks. With the development of machinery and machine systems for performing all face work (cutting, loading, and even roof support work), it is planned that 30 percent of the mine working faces will be exploited by integrated mechanical systems, or machine complexes, compared with 3.5 percent in 1960.

Important to the increased use of mechanized operations is the planned shift to two more productive methods of extraction -- strip and hydraulic mining in which the coal is removed from the face by water jets under pressure and transported hydraulically to the surface. Coal extracted by strip-mining techniques is to amount to slightly more than 23 percent of output planned for 1965 (140 million tons) compared with 20 percent of output in 1958 (about 100 million tons). The development of more highly productive equipment to remove the overburden assumes great importance because it is planned that in 1965 more than 400 million cubic meters of overburden will be removed and that approximately one-half of this amount will be transported from the working areas. Coal mined by hydraulic techniques is planned to increase to 41.6 million tons in 1965 compared with 1.9 million tons in 1960.

The present level of automation is not high in the coal industry. During 1959 and 1960 there was, however, extensive conversion to remote control or automatic control of pumps, ventilators, conveyers, winches, elevators, and systems for hauling and dumping coal cars. It

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is planned by 1965 to mechanize and automate the basic auxiliary operations in surface work, including all operation of winches, ventilators, and pumps. It is planned to introduce integrated automation and mechanization for transportation and cleaning operations at 300 mines and for extraction work in 200 mines. Target levels of integrated automation and mechanization proposed for the Soviet coal industry in 1965 compared with levels in 1960 are shown in the following tabulation:

<u>Type of Operation</u>	<u>Percent of Operations</u>	
	<u>1960</u>	<u>1965 Plan</u>
Extraction	0.8	19.3
Transportation and cleaning	2.5	29.0
Auxiliary (pumping, ventilation, elevators)*	12.0	100

Plans for increasing the amount of coal that is mechanically cleaned emphasize the improvement of equipment and the application of automation. In the USSR, only 27.4 percent of the coal was mechanically cleaned in 1958 compared with about 70 percent in the US (in 1960). The USSR, during 1959-65, plans to construct 105 new cleaning plants with a total capacity of 161.4 million tons. Significantly, only 58 plants with a capacity of 67.7 million tons were constructed in the previous 7-year period.

Soviet studies indicate the feasibility of achieving integrated mechanization and automation of mines producing 50 percent of output of coal within the next 10 to 15 years, thereby freeing 120,000 workers. Fulfillment of this program might help coal to compete with liquid fuels.

b. Modernization and Replacement

From the plans for adding new production capacity, which are large relative to the planned increase in production, it may be inferred that some marginal facilities are to be retired. Furthermore, it is known that at least 12 cleaning plants are scheduled to be reconstructed. Nevertheless, the primary emphasis of the plan is one of expansion of the equipment park rather than one of replacement of any significant amount of equipment.

* Not specified as integrated systems.

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c. Introduction of New Processes

Soviet plans call for increasing extraction of coal by means of strip mining, and they also feature a definite emphasis on hydraulic mining. Strip mining does not involve a new technology and may be viewed as an economical method of extraction to be used wherever possible. Limitations on its use are established by the nature of the geological formations and, to some extent, by the availability of equipment. The USSR is making satisfactory progress in the development of massive and very efficient equipment for strip mining, although schedules for delivery and installation probably will not be realized.

Because the development of hydraulic mining could virtually transform deep mining operations into a flow extraction process, more susceptible than conventional methods to automation, Soviet planners have displayed great interest in this technique. At present it does not seem likely that their hopes, as embodied in the plan for 1965, will be fulfilled. Certain technical problems still are not completely solved. In particular, efficient procedures for drying the coal, such as centrifuges, have not been developed. Furthermore, satisfactory designs have not been developed for the hydromonitors (water jets), high-pressure pumps, feeders, and other necessary equipment such as pipe that will withstand pressures up to 100 atmospheres. These problems appear to have discouraged mine managers from using the new technique to the extent desired by the planners. Finally, the workers appear to have a strong aversion to the difficult and unpleasant working conditions created by the use of large quantities of water.

3. Planned Gains in Labor Productivity

By 1965, labor productivity in the coal industry is planned to increase 30 percent above the level of 1958. Because reduction of the work week is significant in this industry, it should be noted that the plan for an increase of labor productivity corresponds to an increase of 65 to 70 percent on an hourly basis.

Assuming that the goals for 1965 are achieved and that output does increase 23 percent and productivity 30 percent, the number of wage workers needed in 1965 would be 1,013,000 compared with 1,071,000 in 1958 -- a slight net reduction in the labor force.

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X. Production of Electric Power

1. Introduction

Almost 90 percent of production of electric power in the USSR takes place in the powerplants of the centralized electric power industry, which is composed of the state regional powerplants producing for the public supply plus the industrial powerplants that are connected to the regional power systems. The electric power industry uses techniques of mechanization and automation more fully than any other Soviet industry and is one of the most technically advanced branches of industry in the Soviet economy. The remaining 10 percent of the electric power is produced in more than 100,000 small inefficient noncentralized powerplants, which furnish electric power to a single or a limited number of consumers. These small powerplants are outside the power industry, are technically backward, and produce power at very high cost.

In 1958, there were approximately 1 million wage workers engaged in production of electric power in the USSR, or 20 workers per megawatt of installed capacity. Of the total, 222,000 wage workers were employed in the centralized power industry, which required 6 workers per megawatt of installed capacity, whereas the noncentralized powerplants employed about 0.8 million workers and required 61 workers per megawatt.

The total capital investment allocated to the electric power industry in the Seven Year Plan is 12.5 billion to 12.9 billion rubles. Approximately 16 percent of this amount is to be used for the construction of hydroelectric powerplants and 25 percent for the construction of transmission facilities. Except for a small allocation for heating networks, the rest, or about 58 percent, will be used for the construction of thermal electric powerplants. The total new capacity to be added in the industry is 57 million to 60 million kilowatts (kw), including 47 million to 50 million kw in thermal electric powerplants and 10 million to 11 million kw in hydroelectric powerplants. In addition, it is estimated that about 7 million to 9 million kw of powerplant capacity is planned for installation outside the industry, at a total cost of about 2.5 billion rubles.

Significant technical advances in the electric power industry during 1959-65 will come not so much from the greater utilization of automation and new processes as from the use of equipment of higher parameters -- that is, generating equipment with greater unit capacities, operating at higher steam temperatures and pressures. New technology will be introduced only to a limited degree in the large number of small powerplants that operate outside the centralized power industry. However,

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increasing the share of the larger, more efficient centralized powerplants in the total production of electric power from 85.5 percent in 1958 to an estimated 92.6 percent in 1965 would raise the average technical level of power production in the USSR and thus in itself will represent a technical advance.

2. Programs for Technical Advances

a. Introduction of Automatic Equipment and Mechanization

In the Soviet electric power industry the development of automation has entered an advanced stage. Full automation -- with the use of servomechanisms, electrical feedback, and telemechanical control -- is used in production of 80 percent of the power produced by the industry. Hydroelectric powerplants are characterized by a higher degree of automation than thermal electric powerplants, which have a more complex technology. By January 1956, 98 percent of the production capacity of the regional hydroelectric powerplants was equipped with automatic control and 65 percent of this capacity with remote control. Most of the individual processes in thermal electric powerplants have been automated, and attention is now centered on integrating the automation of entire thermal electric powerplants. Means are being worked out for controlling the input of fuel automatically and removing ashes and slag, and devices are being developed to regulate the automatic starting and stopping of boiler-turbine blocs.

Further development of automation in the Soviet electric power industry will be predominantly in the use of closed-loop computer systems for the control of powerplant operations and transmission systems. Computer systems are currently in the experimental stage in the USSR and are only in very limited use in the electric power industry in the US. At present, Soviet experimental work with computers in the field of electric power has advanced the furthest in the study of power system problems. Although this application of computers is limited at present, it can be expected to advance more rapidly than the use of computers to control powerplant operations.

b. Modernization and Replacement

Technical progress in the Soviet electric power industry also calls for an increase in efficiency through modernization or replacement of old equipment. Soviet technicians reportedly have worked out methods of modernizing steam turbines and installing automatic controls that will result in more reliable and economical operation. They also have mentioned the necessity for dismantling small and obsolete powerplants. Sporadic statements concerning the replacement or modernization of powerplant equipment at specific powerplants indicate that replacement and

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modernization is taking place, but no industry-wide plans have been published in spite of the fact that 5 percent of the generating capacity will be of retirement age by 1965.

c. Introduction of New Processes

During the next 5 years, electric power will continue to be produced predominantly by conventional thermal electric and hydroelectric powerplants. It is unlikely that more than 1 percent of the power produced in 1965 will, even in part, utilize new processes.

In the more distant future the most significant new process will be the utilization of nuclear energy to furnish heat for the generation of steam, which will then be used to drive conventional turbogenerators. The USSR has fallen far short of the nuclear power objectives announced in 1956, and the program has continued to fall even further behind since 1958. Soviet officials have stated that they have reduced the nuclear power program for economic reasons, as their nuclear reactors are not yet competitive with conventional power sources. At the end of 1960, there were only 105 megawatts (mw) of nuclear powerplant capacity in operation in the USSR. It is unlikely that more than 700 mw of nuclear capacity will be in operation by the end of 1965, and nuclear power generation will not be economically significant in the USSR during the next 5 years.

The USSR is expanding research on direct power energy conversion systems, including magnetohydrodynamics, semiconductors, and thermionic and fuel cell generation. Such systems would eliminate the necessity for boilers, turbines, and other intermediate transformers of thermal energy into electric energy and could increase greatly the thermal efficiency in power generation. Experimental work also is being done with the solar generation of electric power. Although these sources of power are becoming increasingly important as a subject of research, they are not expected to become economically important in the immediate future.

d. Use of Larger and More Efficient Equipment

During 1959-65, priority has been given to the construction of thermal electric powerplants as the quickest way to acquire additional power-producing capacity with the least capital outlay. In this type of powerplant the cost of fuel represents 70 percent of the cost of production. Technical development, therefore, is aimed primarily at reducing the consumption of fuel per kilowatt-hour (kwh) produced. This consideration has led to the installation of progressively larger units, operating at higher steam pressures and temperatures. At the end of 1958, there were 58 turbogenerators with a capacity of 100 mw each in operation in the USSR and 5 with a capacity of 150 mw each, representing 12 percent

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of the total installed capacity. During 1959-65, 48 percent of the capacity planned for installation will be in units of 150 mw and more. The plan calls for 50 units of 150 mw each, 40 units of 200 mw each, 25 units of 300 mw each, and 2 units of 600 mw each. Large new boilers are being designed to be used in connection with the new turbogenerators. The boilers in use in 1958 had a maximum capacity of 230 tons of steam per hour. Seven boilers capable of producing 640 tons of steam per hour for operation with 200-mw turbines are now in operation, and boilers capable of producing as much as 2,400 tons of steam per hour have been designed.

In hydroelectric powerplants, amortization represents almost 80 percent of the cost of production. Technical innovations are therefore aimed principally at reducing the cost of construction per unit of output. Efforts in this direction have led to the designing of both larger individual hydroelectric powerplants and larger generating units. In addition, new construction methods are being introduced that are expected to reduce considerably both the time and the cost of powerplant construction.

e. Increased Use of More Efficient Processes

Another major technical advance in production of electric power in the USSR during 1959-65 is to be the expansion of the share of the electric power industry in the total production of electric power. The centralized supply of electric power increased from 85.5 percent in 1958 to 88.1 percent in 1960, and it is estimated that it will increase to 92.6 percent in 1965. Because production processes are so much more efficient in the centralized power industry, this expansion will result in a significant economic gain for the economy. In addition, within the electric power industry, the proportion of production by hydroelectric powerplants, where the cost of production is much lower than in thermal electric powerplants, is scheduled to grow from 18 to 22 percent, and production from the more efficient high-pressure thermal electric powerplants is scheduled to grow from 61 percent to almost 85 percent of the total production of thermal electric powerplants.

3. Planned Gains in Labor Productivity

Soviet planners expect that the total number of workers in the centralized electric power industry in the USSR will increase by 25 percent during 1959-65 from a level of 222,000 in 1958 to 280,000 by 1965. During the same period, production by the industry is planned to increase by about 140 percent, indicating a growth in labor productivity of more than 90 percent and an implied saving in manpower of a quarter of a million workers.

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It is estimated that the total labor force in the centralized and noncentralized electric powerplants will increase to a total of about 1.1 million wage workers in 1965, or an average of about 10 workers per megawatt of installed capacity. If the labor factor of 1958 were to continue into 1965, more than 2.1 million workers would be required, indicating a labor saving of about 1 million workers. This great increase in the efficiency of labor would result in part from the further decline in the share of power produced in the relatively labor-intensive, small, noncentralized powerplants and in part from further technical advances in the centralized power industry. Labor savings in the power industry will result not so much from a greater degree of automation as from the increase in the average size of operating units and from the progressive use of liquid and gaseous fuels, which require very little handling compared with solid fuels.

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XI. Petroleum Industry

1. Introduction

The Soviet petroleum industry encompasses the extractive phase of the oil and gas industries; the complex of refineries, synthetic liquid fuel installations, and natural gasoline plants; and the broad and expanding network of oil and gas pipelines, including the many related pump and compressor stations, oil and gas storage facilities, and port storage and handling facilities for petroleum. In 1958 the total employment in the industry amounted to about a quarter of a million wage workers, nearly 40 percent of whom were employed in drilling, 30 percent in production, and 30 percent in refining.*

The total production in the petroleum industry is scheduled to rise substantially during 1959-65. It is estimated that production of crude oil probably will increase from about 113 million tons in 1958 to as much as 265 million tons in 1965, but production of gas, which is planned to increase from about 30 billion to 150 billion cubic meters, probably will amount to no more than 135 billion cubic meters.

During 1959-65 the USSR plans to allocate 16 to 17 percent of its industrial capital investments to the petroleum industry -- an investment amounting to between 17 billion and 17.3 billion rubles. Of this amount, direct capital investment in automation -- that is, investment in control and regulation devices -- is expected to be extremely small and probably will not exceed 100 million rubles, about one-half of which will be for automation in the refineries and the other half for the oilfield program.

The program for technical advances in the Soviet petroleum industry is not a clearly defined, large-scale operating program calling for immediate action (at least not in terms of the availability of investment funds) but rather a long-range planning program, especially with regard to automation. Long-range plans for automation are concerned with remote control and the direction of extraction processes on a broad scale. During 1959-65 the USSR intends to automate only a few refineries and a very limited number of pipelines. In the oilfields the emphasis appears to be only on partial automation, each well to be equipped with some type of limited automatic operation. On the other hand, there is immediate emphasis on technical advances in the industry, especially in mechanization and the introduction of new technology. In 1958, about three-fourths of the wage workers in the industry performed auxiliary work without much mechanical assistance. The USSR hopes to make a substantial improvement through the introduction and application of well-known basic production technology.

* Official Soviet statistics for the petroleum industry in 1958 included as wage workers only those engaged in production and refining -- a total of 138,000 persons.

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Increased labor productivity in 1959 already reflects some success in mechanization. The introduction of new technology in the industry is expected to continue to be fairly successful, especially in the drilling and extractive phases of the industry, where the USSR has made marked improvements in recent years (the introduction of the turbodrill and the electrodrill are among the more notable developments).

2. Programs for Technical Advances

a. Introduction of Automatic Equipment

The USSR is now introducing improved control systems in oil wells and oilfields and by 1965 plans to introduce self-adjusting control systems and full automation in eight refineries. Future oil and gas lines are to have remote control of line operations.

In oilfields the immediate emphasis is on automation of various work and service operations of individual wells. In 1958, about one-half of the wells were equipped with some type of automatic operation, such as air injection, measuring, or the control of pumping jacks. By 1965, about 70 percent of the wells are to be equipped with varying degrees of partial automation.

Planners in the industry have demonstrated great interest in beginning the use of integrated automation and the remote control of extraction processes on the scale of entire fields or administrative areas. To this effect, during the Seven Year Plan the Zay-Karatayev area in the Tatar Council of National Economy (sovmarkhоз) is to be established as a model automated petroleum industrial enterprise. Of a national total of about 30,000 wells in 1958, only 1,000 wells were under remote control. By the end of 1960, more than 6,000 were under remote control.

Other oilfield operations that are planned to be automated in varying degrees by 1965 include the following: 80 percent of the compressor stations, 80 percent of the water pumping stations, 100 percent of the water collection installations, and 75 percent of the oil reservoir park.

Soviet studies have indicated the feasibility of releasing up to one-half of the refinery employees as a result of measures to be taken toward the accomplishment of integrated automation. Extensive work has been done at the Omsk refinery, which is classified as a model experimental plant; the work done here in 1959 was quite successful and has served as the basis for much future planning. During 1959-65, integrated automation is planned for eight refineries, including three currently in operation -- those at Moscow, Ryazan', and Novo-Groznny. The plans project extensive use of instrumentation in the plants and the development of self-adjusting optimizing systems for plant control.

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During 1959-65, 35 pipelines (15 for oil and 20 for gas) are scheduled to be installed or equipped with central dispatcher control (remote control) of operations affecting the flow. So far, no gas lines have been set up for remote control, but present instructions say that all future lines are to be so equipped.

b. Mechanization

In the drilling industry, about 70 percent of the wage workers perform auxiliary work with little mechanical assistance. Efforts are being made to reduce this figure by using portable rigs that reduce the requirements for assembly labor, devices to simplify the replacement of pipe sections, and tractor hoists. Recent efforts to increase the mechanization of pipelaying have virtually transformed the process to one of continuous operation of high efficiency in which the productivity of labor grew rapidly as the new equipment became available.

c. Modernization and Replacement

The work to be done at the Moscow refinery amounts to reconstruction of the plant and will set a precedent for work to be done in other refineries. Present policy emphasizes the desirability of automating and modernizing all refineries having a capacity of more than 2 million tons annual throughput.

d. Introduction of New Processes

Much of the more interesting new technology in the Soviet petroleum industry has been associated with drilling and extraction -- for example, water injection, turbodrills, electrodrills (used for deep drilling), and small-diameter pipe in drilling.

In refining, one of the most important developments is application of automation, although Soviet publications in the field of petroleum carefully avoid any specific definition of the term automation. Basic refinery technology is well known throughout the world, and, except for a growing need for secondary refining (particularly catalytic cracking), there appear to be no particular developments of note in this operation.

3. Planned Gains in Labor Productivity

In 1958, the Soviet petroleum industry employed about 223,000 people, about 138,000 of whom were employed in production and refining. Assuming an increase in production of 150 percent and a planned increase in labor productivity of about 50 percent, the implied savings in manpower in production and refining would amount to about 120,000 wage workers. Applying the productivity and production goals to the industry as a whole, planned savings would amount to about 190,000 workers. The growth of the industry is expected to be so rapid that the labor force will expand considerably in spite of the introduction of new labor-saving measures

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that are planned to save the equivalent of almost 190,000 workers. This calculation is based on an assumed increase in production of 150 percent and a planned gain in labor productivity of approximately 50 percent.

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XII. Construction

1. Introduction

The Soviet construction industry consists of the construction-installation organizations that contract their services to other enterprises and organizations. Construction work also is performed by individual collective farms, by private citizens, and by industrial enterprises under force account (that is, the enterprise does its own construction). In Soviet capital formation the volume of construction-installation work accounts for about two-thirds of the total capital investment (most of the rest of investment is in capital equipment), and approximately two-thirds of the total construction-installation is performed by the construction industry itself. In recent years the labor force engaged directly in contract construction-installation operations has run about 9 percent of the total nonagricultural labor force.

Capital investment in the construction industry during 1959-65 is planned to amount to about 3.3 billion rubles -- 30 percent of the investment planned for the construction and the construction materials industries together and a little more than 3 percent of state investment planned for all industry. The Seven Year Plan calls for the volume of state construction-installation work to increase by 60 percent from 1958 to 1965 and labor productivity in construction by 60 to 65 percent, with the labor force in construction thereby being held to approximately the level of 1958. At the same time, the cost of construction-installation work is to be reduced by at least 6 percent in 1965 compared with that of 1958.

Construction work by its nature is not conducive to automation. Soviet plans for technical change in construction are primarily along two lines: (a) greater mechanization of construction work and (b) the avoidance as much as practicable of heterogeneous, custom-built projects in favor of more uniform, standard end-products in construction. Involved in the latter line of action are the increased use of standard designs of buildings and structures and the increased use of building materials and components prefabricated off-site (particularly precast reinforced-concrete components) as the means of "industrializing" construction -- that is, simulating the more efficient assembling (production) techniques common to industrial enterprises. The Seven Year Plan calls for the transition from simple mechanization to complex

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mechanization in construction to be completed by the end of 1965.* Although the levels of complex mechanization planned for 1965 do not quite reflect "completion," they do call for substantial advances above the levels achieved by 1958. The level of prefabrication in Soviet construction (measured as the share which prefabricated components -- excluding their installation costs -- assume in the cost of all building materials and components used in construction of buildings and structures) is to be raised from 40 percent for construction in general in 1958 to 60 percent in 1965. The economic impact of these planned technical changes in construction can be approximated in the assessments made by Soviet planners, who estimate that slightly more than 40 percent of the planned minimum reduction in the cost of construction-installation work would be attributable to the planned increases in mechanization and that construction costs could be reduced 7 to 8 percent by the end of the Seven Year Plan as a result only of the reduction of the weight of structures achieved through increased prefabrication of lighter building components. Of the planned increase in labor productivity in construction, nearly 40 percent is to come from greater mechanization and slightly more than 25 percent from the greater use of prefabricated components.

2. Programs for Technical Advances

a. Mechanization

The necessity of raising the levels of mechanization, if the labor force in construction is to be held constant, is indicated strikingly by the following increases planned in the physical volume of work to be performed (cubic meters of earthwork, tons of loading and unloading work, and the like) in 1965 above 1958**:

* Complex mechanization in construction does not have quite the implications of integrated mechanization in industry. In the context of the construction industry this process should be interpreted not as complete mechanization but as "comprehensive" or "over-all" mechanization with regard to a given type of construction operation. In complex mechanization of concrete work, for example, the Soviet definition calls for the use of machines in transporting the mix to and within the structure being built and in pouring, placement, and vibration. At the same time, considerable amounts of hand labor would be involved in form work, in tying of reinforcing steel, and in finishing work in the concreting operation.

** That is, the planned increases in these types of work are obtainable only by increased mechanization or by additions to the labor force.

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<u>Type of Construction Work</u>	<u>Percent of Increase</u>
Earthmoving	92
Loading and unloading materials	87
Loading and unloading lumber and metal structurals	95
Loading and unloading cement	112
Installing construction components	161

Thus the Seven Year Plan calls for quite substantial increases in the levels of mechanization of various construction operations (see Table 3).

Table 3

USSR: Mechanization of Construction Work, by Selected Category
1958 and 1965 Plan

<u>Mechanized Work as a Percent of the Total Volume of Work</u>	<u>1958</u>	<u>1965 Plan</u>
Complex mechanization		
Earthmoving	83	95
Installing construction components	82	96
Concrete work	68	90
Preparing concrete	77	91
Preparing mortar	60	81
Mechanization of loading and unloading materials		
Rock products	85	94
Construction components, lumber, and metal	83	90
Cement	43	90

In the basic operations, construction machines are extremely efficient substitutes for hand labor. For example, the volume of earth-work performed entirely by hand was only 6 percent of the total volume of earthwork performed in construction in 1958, yet approximately 50 percent of the total number of construction workers employed in earthwork were required to perform that 6 percent; in loading-unloading work, 40 percent was performed entirely by hand, requiring 70 percent of the total number of workers in loading-unloading operations. In total (including the large number of manual workers required even in the portions of

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construction work partly or complexly mechanized and in subsidiary construction activities), approximately 60 percent of the total number of construction workers were engaged in hand labor in 1958, or 3 million out of 5 million.

According to Soviet estimates, achievement of the plans for mechanization during 1959-65 would permit the transfer of 900,000 construction workers from manual to mechanized labor. Thus 18 percent of the total work force of 1958 is planned to be transferred from hand labor to mechanized labor (or 30 percent of the work force engaged in hand labor) in the short span of 7 years. Even if this goal were achieved, however, there would still be a large reserve for further transfers of hand labor to mechanized labor, with roughly 42 percent of the construction work force still engaged in manual labor compared with 60 percent in 1958.

As the major means of raising the levels of mechanization in construction at the same time that an ever greater volume of construction is to be performed, the Seven Year Plan calls for substantial additions to the park of basic construction equipment used in construction (see Table 4*). Changes in the quality and capacity of the equipment are not revealed in these data. A reduction in the average capacity of the excavator park by 1965 appears to be certain as a consequence of the plan, but it is impossible to determine whether this change reflects a wise adaptation to changing requirements in excavating operations or simply the inadequacy of Soviet planning indexes. Except for excavators, however, it is likely that fulfillment of the Seven Year Plan generally would increase the average capacity of the equipment park by 1965 and also would mean an improvement in the assortment of given types of equipment.

Fulfillment of the Seven Year Plan for the basic park would result in substantial increases in the numbers of excavators, bulldozers, and mobile cranes available per unit volume of construction-installation planned for 1965. Although the relative availability of scrapers would be less at the end of the plan period than at the beginning, the park is to be modernized substantially and therefore will be of greater average capacity.** The park of construction equipment used in construction per hundred million rubles of construction-installation work would increase under the plan for 1965 compared with 1958 as follows***:

* Table 4 follows on p. 51.

** See b, p. 51, below.

*** Park data are as of the end of each year. Plan data for 1965 were derived by increasing the volume of state and noncentralized construction-installation work performed in 1958 by the 60-percent increase planned for state construction-installation.

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<u>Year</u>	<u>Excavators</u>	<u>Scrapers</u>	<u>Bulldozers</u>	<u>Mobile Cranes</u>
1958	190	70	195	278
1965 Plan	333	66	242	400

Table 4

USSR: Changes in the Park of Construction Equipment
by Selected Types of Equipment
1958 and 1965 Plan a/

<u>Types of Equipment</u>	<u>1958</u>	<u>1965 Plan b/</u>
Excavators	28,500	80,000
Scrapers	10,500	15,800
Bulldozers	29,162	58,000
Mobile cranes	41,743	96,000

a. End-of-year data.

b. Plans were revised upward about the middle of 1960.

As an integral part of the plan for greater mechanization and as a means of easing the requirements for additional equipment, the Soviet authorities plan to expand the use of two shifts a day in the operation of construction equipment. Their basic construction equipment is worked an average of 1,800 to 2,300 hours annually, whereas their studies indicate that under "modern" operating conditions working time can be raised to 3,000 to 3,500 hours per year. The Seven Year Plan therefore calls for the working time of scrapers, bulldozers, installation cranes, and loading equipment to be increased by 25 to 40 percent, raising the annual working time to 2,500 to 3,500 hours.

b. Modernization and Replacement

Planned retirements of several types of construction equipment can be derived by comparing the park data for 1958 and planned for 1965 with the Seven Year Plan for gross deliveries of equipment to construction organizations. Thus by the end of 1965 it is planned that 33 percent of the excavator park of 1958 will have been retired, 79 percent of the scraper park, and 21 percent of the mobile crane park.

Modernization of the excavator park, with three-fourths of the 1965 park made up of excavators delivered during 1959-65, is planned

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largely in the form of a shift in the structure of the park to a very large proportion of the smaller types of single-bucket excavators. Although there is a substantial need for modernization of several types of mobile cranes, particularly in the form of greater lifting capacities, the Seven Year Plan apparently is rather modest in this respect. Approximately three-fourths of the park of both tower cranes and truck cranes at the beginning of the Seven Year Plan consisted of obsolete types with inadequate lifting capacities, yet the plan would have one-third of the 1965 park of mobile cranes made up of cranes that were operating in 1958 or earlier.

The high retirement rate planned for the scraper park reflects the extensive modernization program. Much of the scraper park of 1958 was obsolete or of small capacity and consisted entirely of towed units; self-propelled scrapers were not in series production until 1959-60. Soviet authorities estimate that the self-propelled scraper is twice as productive as a tractor-drawn scraper of identical capacity and that it reduces earthmoving costs by an average of 30 percent. Until the Seven Year Plan, however, the USSR has been slow to take advantage of the efficiency of scrapers in earthwork (the generally colder climate and therefore shorter working season for scrapers in the USSR only partly accounts for the overwhelming reliance on excavators). Nearly 60 percent of the total gross deliveries of scrapers scheduled for 1959-65 are to be of the self-propelled type. Thus, although it had been recommended that at least 30 to 40 percent of the 1965 park of scrapers be of the self-propelled type, fulfillment of the Seven Year Plan goals actually would result in 50 percent of the park being of this kind.

c. Introduction of New Processes

To Soviet planners the most important feature of the development of new construction techniques is the drive to "industrialize" construction, which itself is epitomized by the drive toward greater use of prefabricated building components, turned out off-site under mass-production techniques in a factory or casting yard and rapidly erected on-site into buildings and structures. The level of prefabrication in construction in general is to be raised from 40 percent in 1958 to 60 percent in 1965, in housing construction from 56 percent to 70 percent, and in industrial construction from 23 percent to 60 percent.

The Seven Year Plan calls for a very substantial technical change in the construction of urban housing under the state category -- a decided shift away from brick to apartment housing built of prefabricated large panels of reinforced concrete. Thus large-panel housing construction is to account for 63 percent of the living space to be completed in state urban housing in 1965 compared with a mere 3 percent in

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1959; brick, on the other hand, is to decline to only 10 percent in 1965 compared with 52 percent in 1959.

The construction field has its equivalent of the model experimental enterprise in industry. "Model construction projects" have been set up in the USSR as sites for field testing, implementation, and dissemination of modern or innovative techniques and methods in construction, particularly in industrial construction. The volume of model construction is to be raised from 3 percent of the volume of state construction in 1959 to nearly 5 percent in 1965.

3. Planned Gains in Labor Productivity

The Seven Year Plan calls for labor productivity in construction in increase by 60 to 65 percent during 1959-65. According to Soviet calculations, the planned increases break down into the following categories, which add to 60 to 65 percent:

	Percent	
	Increase in Productivity in 1965 Compared with 1958	Share of the total Planned Increase
Greater use of prefabricated components	16 to 17	27
Greater mechanization of construction	23 to 25	38
Improvement in the organization and technology of construction work	21 to 23	35
Total	<u>60</u> to <u>65</u>	<u>100</u>

Planned savings in labor can be roughly estimated by comparing the planned increases in labor productivity (60 to 65 percent) and in the volume of construction-installation work (60 percent) with the employment level of 1958 (5 million construction workers). If productivity and production goals are achieved in 1965, there would therefore be an implied labor saving of approximately 3 million workers. Or, in other words, the volume of construction-installation planned for 1965 would be attained without the additional 3 million workers that would have been required if labor productivity had remained at the level of 1958. Of the labor saving of 3 million workers, approximately 27 percent (or 0.8 million workers) would accrue from the greater use of prefabricated components and 38 percent (or 1.2 million workers) from greater mechanization in construction.

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XIII. Railroad Transport

1. Introduction

Soviet railroad transport consists of the transportation of freight and passengers over a main-line, national, unified common-carrier railroad system. Soviet railroads account for a disproportionately large share of the total inland transport performance -- in 1958, they hauled 1,302 billion ton-kilometers (tkm), or about 85 percent of the total traffic turnover by all carriers. Traffic handled by the railroads is scheduled to increase by more than 40 percent during the Seven Year Plan, and capital investment during that time, 11.0 billion to 11.5 billion rubles, will be 90 percent greater than during the preceding 7 years.

The labor force of the Ministry of Railroads totaled nearly 3.5 million persons in 1958. Of this number, 2 million were operating employees directly associated with the transportation process, and the remaining 1.5 million were employed in management, industry, research, education, and communal services.

Conversion from steam to electric and diesel traction is the most significant of the programs for investment and technical change in the industry, with respect to both the volume of investment capital involved and the impact on capital and labor productivity. Of the 11.0 billion to 11.5 billion rubles of investment funds allocated to the railroads during 1959-65, 3.6 billion (32 percent) are for the acquisition of new diesel and electric motive power and 1.35 billion (12 percent) are for fixed electrification facilities. During the plan period the share of ton-kilometers performed by diesel and electric traction is to increase from 26 percent to between 85 and 87 percent.

About 2.3 billion rubles (20 percent of planned investment during 1959-65) are for new freight and passenger cars and modernization of the existing inventory, and 1.4 billion rubles (12 percent of planned investment) are for the expansion and modernization of yards and terminals; other acquisitions; and design, production, and construction work. The sum of 0.5 billion rubles (4 percent) is for signals, communications, and other automatic or semiautomatic installations such as automatic classification yards and remote control of interlocking station signals and switches. Only 2.2 billion rubles (20 percent of planned investment) are for double tracking and construction of new lines.

The acquisition of new motive power and other improvements will enable the Soviet railroads by 1965 to increase gross ton-kilometers per

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freight-train-hour, generally regarded as the best single index of line-haul efficiency, by 42 percent. Labor productivity of operating employees is to increase 34 percent, and operating costs per traffic-kilometer are to decrease 21 percent. The first three annual investment plans were not quite fulfilled, but plans for increases in labor productivity were overfulfilled.

Soviet plans for technological advances in railroad transport emphasize re-equipment and modernization of the existing main-line system, which involves the acquisition of improved motive power and cars and the improvement of the fixed facilities over which they operate. Soviet railroads are worked at very near capacity, and, in order to handle the increases in traffic that accrue regularly, line capacity has to be continually augmented. Traffic density is planned to increase from 10.6 million tkm per kilometer of line.

2. Programs for Technical Advances

Railroads utilize a large number of types of equipment and processes both in transport and in maintenance of transportation equipment and facilities, ranging from manual devices to equipment that is fully automatically controlled. Because of the diverse nature of the equipment and processes, it is necessary to differentiate between major categories and functions in assessing technical levels. The potential uses of automation in transportation are considerable and can best be understood by visualizing a flow of units of freight moving uninterruptedly from an origin to a destination. Because the distances are great and the goods diverse, the creation of such an uninterrupted and automatic flow is a complex process on railroads. Technological characteristics of the various stages of the process and elements contributing to the process tend to vary widely.

a. Introduction of Automatic Equipment

The control function that regulates the movement of cargo units over the railroad network is most subject to automatic control. During the Seven Year Plan, Soviet railroads will be equipped with 8,000 to 10,000 kilometers (km) of automatic block signaling and 10,000 km of centralized traffic control, bringing the total length of rail line equipped with advanced signaling to 40,700 to 42,700 km. It is possible to increase the capacity of rail lines as much as 50 to 100 percent and at the same time decrease the staff and lower other operating costs by introducing this equipment. Since the adoption of the plan the decision has been reached to equip a large number of lines not scheduled for new signal installations with semiautomatic bloc signaling (remote but local control of signals and switches at way stations). About 25 percent of the labor saving during the plan period will result

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from the elimination of switchmen and switch and signal maintainers. Station interlocking -- simultaneous remote control of series of switches and signals -- also is being installed on a regular basis each year, although no specific plan is available. Other major elements in the automation of train and car movement are well understood in the USSR but will not be widely introduced during the present plan. Research is underway that will make possible the automatic control of the motive power unit, programing and fully automating the movement of trains and cars on main lines and in yards and stations. Automatic control of power supply is beginning to be introduced in new electrification projects.

b. Mechanization

Considerable new maintenance of way equipment of all types is to be available for use by the railroads by 1965. Nearly all of this equipment can be defined as mechanized. As a result of the increased use of such equipment, the level of mechanization is planned to grow during 1959-65 as follows: for construction and capital maintenance, from 43 to 77 percent; for intermediate maintenance, from 33.5 to 70 percent; and for current maintenance, from 10.9 to 40 percent. This increase in mechanization is to release more than 50,000 employees from manual labor.

c. Modernization and Replacement

Modernization and replacement of motive power and cars accounts for 52 percent of the investment program for 1959-65. It is estimated that during the 7-year period 22,500 main-line steam locomotives -- nearly 70 percent of the 1958 inventory -- will be retired and replaced by about 17,000 diesel and electric units. The capacity in horsepower of the inventory of main-line diesel and electric locomotives is planned to increase nearly three times.

It is estimated that the inventory of freight cars will increase by 100,000 units, or 11 percent. The total estimated capacity of the inventory will increase 32 percent by 1965, as the average capacity of annual additions is planned to increase steadily and to reach 70 to 75 tons in 1965. The average capacity of cars acquired in 1958 was 59 tons. It is estimated that about 130,000 obsolete cars of low capacity will be retired.

d. Introduction of New Processes

Significant increases in the transportation of petroleum and natural gas by pipeline represent an important shift to a transportation process previously little used in the USSR. The expected transmission of

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natural gas by pipeline in 1965, converted in terms of standard fuel units, is equal to 200 million tons of coal and (assuming the average length of haul for Soviet coal in 1960) to 135 billion tkm. Traffic on petroleum pipelines is expected to reach 185 billion tkm in 1965. The implicit labor saving resulting from the movement of this volume of energy by pipeline as opposed to railroads in 1965 is about 300,000 employees.

3. Planned Gains in Labor Productivity

Assuming that planned traffic levels on the railroads are reached, achievement of the labor productivity target would represent a labor saving of about 700,000 to 800,000 persons in 1965, and the total labor force of 2 million operating employees in 1958 would have an absolute increase of about 80,000, or 4 percent. Most of the labor saving could be attributed to the increased use of relatively advanced equipment and improved technology and the more intensive utilization of existing facilities made possible by these improvements.

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XIV. Communications1. Introduction

The Soviet Ministry of Communications, which is responsible for the civil post and telecommunications sector of the economy, had a labor force of about 0.7 million workers in 1958. Of this total, 50 percent were employed in the postal system, 15 percent in the telephone system, 12 percent in the telegraph system, 9 percent in the broadcasting system, 6 percent in the common carrier system, and 8 percent in miscellaneous fields.

The first capital inventory by the Ministry of Communications in 1959 placed the capital value of its facilities at 2.19 billion rubles.* An investment fund of 1.5 billion rubles has been allotted the Ministry for 1959-65, double that for the previous 7 years. It is estimated that these funds will be allocated within the Ministry as follows: 37 percent for common carriers, 25 percent for broadcasting, 15 percent for telephone facilities, 15 percent for postal facilities, 5 percent for housing, and 3 percent for telegraph services. Based on anticipated revenue, performance of the post and telecommunications sector is estimated to increase by 71 percent.

Under the provisions of the Seven Year Plan the USSR for the first time has begun extensive exploitation of modern technology for the post and telecommunications sector. This sector has long suffered from low priority and has not been able to give the amounts or the kinds and quality of service long judged to be needed by the Ministry of Communications to support rapid economic growth.

The overriding technological objective of the Seven Year Plan is to commence the building of a new automated arterial communications base of common carrier facilities that are somewhat comparable in technological stature to those found in Western countries today. Other technological provisions include the following: automated broadcast stations, automatic and semiautomatic telephone and telegraph exchanges, automated common carrier lines, modern telegraph apparatus, and mechanized and automated mail-handling equipment.

The development of an arterial network of common carrier facilities during the Seven Year Plan will enable the Ministry of Communications to initiate the provision of automated services -- such as teledata, telecontrol, and telemetering -- tailored to meet the needs of the Soviet economy. At the same time, the new arterial network will provide nationwide links for all sectors of the economy wishing to conduct these

* Replacement cost expressed in 1955 prices in new rubles.

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automated services for themselves. Furthermore, the realization of technological goals will improve the coverage, speed, and quality of conventional post and telecommunications services. With the exception of subscriber telegraph and broadcasting services, however, no major improvement is foreseen in the availability of service, especially to the public, because the provision of telephone and telegraph equipment will lag behind the construction of the arterial network of common carrier facilities on which the equipment ultimately will be used.

2. Programs for Technical Advances

The technological goals for 1959-65 provide for the application of proved communications techniques, many of which before 1959 had not progressed beyond the stage of research and development in the USSR, although they were well known and widely used in Western countries.

The Ministry of Communications is giving primary emphasis in its plans to the establishment of an extensive arterial network of common carrier facilities employing a high degree of automation. Seventy percent of the repeater points on cable lines and relay stations on microwave radio relay lines are to be unattended and remotely controlled. Multiplexing equipment will provide capacities of 1,920 telephone channels per coaxial-pair on coaxial cable lines; 12, 24, or 60 telephone channels per cable-pair on multiconductor cable lines; and 60 to 600 telephone channels per radio-frequency trunk on microwave radio-relay lines. In addition, microwave and coaxial cable lines will be capable of carrying television transmissions. Toward the end of this plan period, miniature coaxial cable lines are scheduled to be introduced that will use solid-state components in unattended repeater points and will have a capacity of 300 telephone channels.

Other significant common carrier developments will include the new single-sideband and tropospheric scatter radio techniques. On main and secondary point-to-point radio circuits, single-sideband radio facilities will use high-frequency transmitters having powers of 1, 5, and 20 kilowatts. Tropospheric scatter equipment will have a capacity of 60 to 120 telephone channels or 1 television channel per radio-frequency trunk.

Plans for the expansion of telephone and telegraph facilities are far less extensive than those for common carrier facilities, but the use of automated and modernized equipment will be emphasized. In urban, rural, and interurban telephone networks, modern crossbar exchanges are to be installed and existing automatic exchanges modernized. Ninety percent of the total urban telephone exchange capacity and 53 percent of the total rural telephone exchange capacity will be automated by 1965. In the field of telegraphy, modern teletype apparatus will

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replace obsolescent Morse and Baudot manual equipment. Some automatic telegraph relay equipment will be available, but the primary innovation will be the use of perforated tape for semiautomatic relay so as to avoid manual reperforation. Automatic exchange equipment will be utilized in expanding the subscriber telegraph network, which will be 100 percent automatic or semiautomatic by 1965, and modern apparatus will be introduced on subscriber and public facsimile networks.

Automation is the key to the ambitious expansion of broadcasting service. Amplitude-modulation (AM) and frequency-modulation (FM) radio-broadcasting stations will employ automated transmitters that can be remotely controlled and supervised. Television transmitters and wire-diffusion amplifiers will have similar automatic features. In addition, modern technology will permit the initiation of color television and stereophonic radiobroadcasting services.

In the postal system, efforts will be concentrated on the mechanization of mail-handling operations. Fifty major postal enterprises will be 100 percent mechanized and automated, and 150 other major postal enterprises will be 80 percent mechanized. A limited amount of automation is planned for mail sorting, canceling, and vending operations.

3. Planned Gains in Labor Productivity

Because most technological developments during the Seven Year Plan will not contribute directly to increases in the volume of post and telecommunications service, planned gains in labor productivity of 30 to 35 percent are relatively modest. The realization of these gains would reduce the labor force requirements for 1965 by about 0.3 million workers, although there will be some increase in total employment.

Some of the benefits of past growth in labor productivity have been passed on to the labor force in the form of shorter hours and increased wages. The workweek was reduced from 46 to 41 hours in 1960 and will be reduced to 40 hours in 1962. Average wages were increased in 1960-61 by 25 to 30 percent. Some workers in the lower brackets, mainly postal and telephone employees, received increases as high as 50 percent.

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XV. Handling of Materials

1. Introduction

One in every five Soviet industrial wage workers is occupied in transporting and handling materials within the plant. These workers must move annually more than 8 billion tons of material with their hands or with inefficient machinery. As a matter of policy, Soviet planners intend to reduce employment in this activity during the Seven Year Plan and to increase the mechanization of handling materials. As a matter of practice, the formulation and implementation of the plan is left up to the various industries. The plans for labor saving surveyed in the preceding pages included such plans as had been devised for the reduction of employment in the handling of materials. This section is a summary of data from the various sections on industry in this report.

Soviet industry in 1958 employed 3.7 million wage workers in transporting and handling materials within the plant. Of this total, 58 percent were employed in the following four industries: machine building and metalworking (0.7 million), coal (0.5 million), logging (0.5 million), and food (0.4 million). Although 75 percent of the total volume of goods is moved with the use of some machinery, probably at least one-half of the workers employed in this type of work do a significant amount of manual labor. In the machine construction plants of the RSFSR in 1958, for example, 85 percent of the 260,000 loaders performed manual physical labor.

From the limited data available, it appears that the planners expect the volume of transporting and handling materials within the plants to increase at least 38 percent during the Seven Year Plan.* These plans (which usually underestimate transport requirements) call for increasing the productivity of labor by 55 to 60 percent and for reducing the cost of handling goods by 15 to 20 percent.

2. Programs for Technical Advances

Achievement of the Soviet plans requires no breakthrough in technology but rather an adequate supply of equipment for the technology presently known. The original plans for 1959-65 called for a production of 2.15 billion rubles of hoist-transport equipment** and a

* RSFSR data show a planned increase in the movement of materials in RSFSR enterprises from 6 billion tons in 1958 to 8.3 billion tons in 1965.

** This figure may represent output in the RSFSR only.

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doubling of output in 1965 compared with 1958. An alternative plan has been proposed that calls for a 1965 target to be 50 percent higher than the original target, on the basis of complaints that achievement of the original targets would not satisfy demand. In addition to revising production schedules, Soviet planners call for measures to improve the utilization of the present equipment park, which, on the average, is now in use only one-half of the working time.

Implementation of the plans would permit a modest rise in productivity, but the rise would not be out of line with past experience. Soviet studies now indicate that output per worker in the handling of materials presently ranges from 3 to 5 tons of material per shift in plants with low mechanization to a range of 15 to 20 tons in plants with higher mechanization. In plants with integrated mechanization the handling totals jump to 250 to 330 tons per worker per shift, or nearly 90,000 tons per worker per year. Present plans imply a jump from an average of approximately 8 tons handled per worker per shift to a figure in 1965 of approximately 12 tons per worker per shift.

3. Planned Gains in Labor Productivity

Assuming that 38 percent more material is moved in Soviet plants in 1965 than in 1958, achievement of an increase of 55 to 60 percent in labor productivity would imply a labor saving of 1.8 to 1.9 million wage workers in 1965 and a reduction of the total employment in this type of work.

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XVI. Equipment for Administrative Control

At the present time, according to a Gosplan estimate, about 10 million persons in the USSR are engaged in engineering, technical, and administrative control work.

To supply these workers with the estimated requirements for typewriters, adding machines, calculators, drawing equipment, duplicating and printing equipment, dictaphones, industrial television, and data transmission systems would require an expenditure of nearly 2.7 billion rubles. The Seven Year Plan calls for nearly 0.9 billion rubles of the desired equipment to be furnished by the end of 1965 in addition to the present inventory valued at approximately 0.25 billion rubles. Information provided by a Gosplan official on the planned mechanization of administrative work is summarized in Table 5.*

In 1960 it was announced that, as part of the program to develop and utilize computer technology, large enterprises and computer centers were to receive 200 high-speed electronic computers during the Seven Year Plan, the first being designated for the Likhachev automobile plant. Medium-size enterprises are to receive more than 900 medium-capacity computers and more than 600 low-capacity computers. A gradual transition is to be begun toward production and allocation of electronic data-processing systems.

Soviet officials estimate that increasing the park of accounting and calculating machines in the USSR to 500,000 units by 1965, as planned, would reduce labor requirements in accounting and calculating work by some 0.3 million wage workers. Additional large savings could be expected from mechanization of documentation, drawing and design work, and copying work.

* Table 5 follows on p. 66.

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Table 5

USSR: Gosplan Data on Requirements and Supply of Equipment
for Administrative Needs and Data Processing
January 1960 and January 1966

Type of Equipment	As of January 1960		As of January 1966 (Planned)		
	Billion New Rubles	Percent of Requirement	Billion New Rubles	Percent of Requirement	
Available	Needed	Available	Needed	Available	
Calculating (for administration and accounting) ^{a/}	0.10	1.00	10.0	0.50	1.25
Transmitting, controlling, and directing	0.05	0.75	6.7	0.20	0.90
Typewriting and dictating	0.04	0.24	16.7	0.16	0.26
Drawing and design	0.01	0.06	16.7	0.06	0.10
Copying and reproducing	0.01	0.20	5.0	0.11	0.22
Special furniture (cabinets and chairs for data-processors and controllers)	0.04	0.18	22.2	0.10	0.20
				50.0	

a. The Soviet plan is not clear as to the inclusiveness of this category -- for example, electronic computers may be included.

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APPENDIX

DEFINITIONS OF TERMS RELATING TO AUTOMATION AND MECHANIZATION

Recurring in Soviet plans are certain terms for which it is necessary to establish some basic definitions. These terms, however, are not fully standardized, being defined in various ways or being used loosely or vaguely by Soviet writers.

The most important concepts relate to the subjects of mechanization and automation. The fact that the terms mechanization and automation are not mutually exclusive leads to much confusion. In a very real sense, automation is a higher form of mechanization because it connotes the mechanization of the human functions of control and regulation. It would be possible to have mechanization without automation but not automation without mechanization. In all likelihood, this relationship is the probable reason for the frequent use in Soviet publications of the term complex mechanization and automation. Achievement of this state implies that production operations are all mechanized and that machines or mechanisms perform functions of regulation and control. Many Soviet authors use the word automation in the sense of a high form of "machine system" rather than in the sense of an "automatic machine" (whether an automatic lathe or a laundromat). Thus a distinction is made between the degree of automation in an "individual" machine and the degree of automation in a "system" of machinery.

The following definitions pertain to the levels of mechanization of a single work operation:

Hand work (or manual labor): the use of the hands alone, as in lifting.

Hand tool: the use of some implement, such as a hammer.

Hand mechanism: the use of some machine that must be held by the hands, such as an airhammer.

Nonautomatic machine: the use of a fixed or mobile machine in which the operations of the machine are directly guided by the worker, as in the use of a machine lathe.

Semiautomatic machine: the use of a machine that performs a work cycle automatically and then must be stopped, the article must be removed and a new one must be inserted by a worker, who then starts the machine again.

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Cyclical automatic machine: the use of a machine that performs a given work cycle without the need of human intervention, although human supervision of the machine is required.

Reflex and programed automatic units: the use of a machine in which the task of supervision and the correction of deviations from the work assignment are performed by the machine itself with the aid of electronic or other systems.

(It should be noted that the term automatic machinery is often used indiscriminately in all of the above senses except in hand work and in the use of hand tools.)

The following definitions pertain to groups of operations:

Flow lines: groups of machines linked mechanically for transport (as in conveyer systems) where the machinery is not automatic and requires intervention by the worker.

Cyclical automatic blocks of machinery: groups of automatic (sometimes semiautomatic) machines linked directly by special transport and synchronizing control systems, so that direct human intervention is not required in the sequence of production operations. As indicated, the operation is cyclical in nature rather than susceptible to manipulation from a central control board. An automatic transfer line consisting of linked automatic machine tools is an example of this category.

Reflex automatic blocks of machinery: automatic systems of machinery controlled centrally through a central control panel on the basis of electronic instrumentation and servo-mechanisms. In Western technology these systems are known as "open loop" systems.

Self-adjusting automatic blocks of machinery: reflex automatic blocks of machinery in which actual tasks are controlled and changed by means of a computer, which "closes the loop" and creates the "closed loop" system of Western technology.

Automatic combines: a theoretical concept that recognizes that different types of systems may be linked automatically. Thus an automatic combine might link the sequence of extracting, processing, storing, and distributing a commodity.

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Central control of bloc systems: a logical culmination that takes the form of a control pyramid, with a computer making key decisions which are transmitted to other computers that in turn actually control process systems.

Generally, when Soviet authors use the term mechanization, they are usually discussing the substitution of machinery for manual labor, a process that still has far to go if Soviet statistics on the prevalence of manual labor are accurate. "Integrated (complex) mechanization" signifies mechanization of all interrelated processes without the necessity for the expenditure of hand labor in the production process.

The term automation is often used ambiguously in the USSR, signifying either the use of automatic machine units or more commonly the use of some form of automated machine system. "Partial automation" implies the use of automatic machinery for particular operations but a state of incomplete automation of a production process. "Complex automation" implies the use of a system of automatic machines for a process that produces some article, often an intermediate part. In higher forms, complex automation may evolve into an "automatic section," an "automatic shop," or an "automatic plant." "Full automation" implies the presence of some form of "reflex system," either "open loop" or "closed loop." The "means of automation" is a generic term which covers the following types of equipment and systems -- sensors, amplifiers, electronic data processing and computers, control panels, and servomechanisms -- but which does not include process equipment as such.